DOCUMENT RESUME

ED 142 691 CE 011 149

| | |
|---|---|
| AUTHOR | Powers, Thomas F., Ed.; Swinton, John R., Ed. |
| TITLE | Forecasting the Future Food Service World of Work. Final Report. Volume III. Technical Papers on the Future of the Food Service Industry. Service Management Reports. |
| INSTITUTION | Pennsylvania State Univ., University Park. Food Service and Housing Administration. |
| SPONS AGENCY | Pennsylvania Research Coordinating Unit for Vocational Education, Harrisburg. |
| BUREAU NO | 19-4009 |
| PUB DATE | 30 Jun 77 |
| NOTE | 375p.; For related documents see CE 011 147-149 |
| AVAILABLE FROM | Pennsylvania State University, Service Management Reports, Food Service and Housing Administration, Henderson Human Development Building, University Park, Pennsylvania 16802 ($15.95) |
| EDRS PRICE | MF-$0.83 HC-$19.41 Plus Postage. |
| DESCRIPTORS | *Consumer Economics; Dining Facilities; Facility Requirements; Food Processing Occupations; *Food Service; Food Service Industry; Food Service Occupations; Food Standards; Marketing; *Nutrition; *Perception Tests; Quality Control; Research Projects; Sensory Experience; Technical Reports |
| IDENTIFIERS | Pennsylvania |

ABSTRACT

This third and final volume of a study on the future of the food service industry contains the technical papers on which the information in the previous two volumes was based. The papers were written by various members of the Pennsylvania State University departments of economics, food science, nutrition, social psychology, and engineering and by members of the university's Food Service and Housing Administration. Titles of the studies included are "Consumer Perceptions of and Innovative Behavior Toward New Food Products"; "The Pennsylvania State University's Consumer Taste Panel Experiment"; "Sensory Evaluation of Freshly Prepared and Frozen-Reconstituted Gourmet Food Items at the Pennsylvania State University's Division of Food Science and Industry"; "The Potential Impact of Nutrition Delivery Systems on Food Nutrient Retention: Results of a Pilot Study"; "Seven Food Processing and Preparation Heat Transfer Experiments"; "Systems for Controlling the Physical Environment of Food Service Establishments: A Look at the Future"; "A Dynamic Model of Consumer Demand for Away-from-Home Food"; "A Study of Guests' Perceptions of Restaurant Servers"; and "A Nutritional Analysis of Consumer Choices in Fast Food Restaurants." (BM)

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ED142691

# FINAL REPORT

# TECHNICAL PAPERS
# ON THE
# FUTURE OF THE FOOD SERVICE INDUSTRY

## Forecasting the Future Food Service World of Work
## Volume III

(Project No. 19-4009)

edited by

Thomas F. Powers, Ph.D.

with

John R. Swinton

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## Introduction and Acknowledgments

A great deal of work by many people has gone into the Pennsylvania State University Food Service and Housing Administration (FSHA) Program's development of a view of the food service industry of the future. In an earlier report, The Future of Food Service: A Basis for Planning (1974), we presented our first year literature search and planning study. In Volumes I and II of this report, we have presented views of the food service industry of 1985 and a technical study on centralized food service systems, respectively.

Those two volumes were made possible, in large part, by the efforts of colleagues in the areas of economics, food science, nutrition, social psychology, and engineering, as well as FSHA. Their work, quietly but critically integrated into the chapters of the first two volumes, is set forth in its more technical form in this volume. A reader should bear in mind that these chapters present disparate, individualized points of view. Thus, he may choose, after studying this volume, to agree or disagree about the specific aspects of the future of food service he encounters. We here at Penn State, however, see that future, overall, as indeed quite promising.

I have already acknowledged those who helped formulate, oversee, and produce these three volumes. I would, nevertheless, remind readers of the gratitude I owe Dr. Clarence Dittenhafer of the Research Coordinating Unit of the Pennsylvania Department of Education; Dr. Carroll Curtis, Director of the Research Coordinating Unit; Ms. Carolyn Kratz, Senior Program Specialist in Home Economics in the Pennsylvania Department of

Education; the FSHA faculty, including our editor, John Swinton, Assistant Professor Leo Renaghan, and my wife, Jo Marie Powers; and the FSHA clerical and secretarial staff, including Rhoda, Bonnie, and Vera Williams, Ruth Kilhofer, Anna Mortimer, and Cindy Brown.

As I remarked in the previous two volumes of this report, those of us who contributed to this project feel that we have laid the groundwork for important work at all levels of Hospitality Education. Once again, the Pennsylvania Department of Education has demonstrated, almost uniquely among funding agencies, an awareness of the need to provide substance before providing form in Hospitality Education. The Research Coordinating Unit of that department has been an exacting taskmaster, but that approach has been most productive for those of us who worked on this project. The effects of the work set forth in these three volumes will certainly be felt in the immediate future of Hospitality Education. But it will also continue to be felt for many years to come.

Thomas F. Powers

June 30, 1975
University Park, Pennsylvania

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# CONSUMER PERCEPTIONS OF AND INNOVATIVE BEHAVIOR TOWARD NEW FOOD PRODUCTS

by

Leo M. Renaghan, M.B.A.

# CONSUMER PERCEPTIONS OF AND INNOVATIVE BEHAVIOR TOWARD NEW FOOD PRODUCTS

## Introduction*

Imagine entering a restaurant, opening your menu, and discovering the following selection:

Canapes of Krill

A delicious spread made from the krill (a small, shrimplike creature from the cold waters of the Antarctic) served on wheat thins and garnished with a variety of interesting foods. Canapes come six to an order, and each is served with fresh lemon to bring out the delicate shrimp flavor.

Creamed Soy Chicken, Southern Style

This tasty dish is made from textured vegetable protein, shaped in cubes and laced with real chicken flavor. The dish is combined with fresh vegetables and herbs in a smooth cream sauce and is served in a flakey, fresh-baked pastry shell.

Fresh Kelp Salad

Our kelp arrives twice weekly by the most direct route from southern sea beds to ensure freshness. We serve it with your favorite dressing. (We recommend our own imitation Bleu Cheese dressing--"you can't tell the difference !")

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*The author gratefully acknowledges the assistance of Deborah J. Miller in the collection and analysis of the data for this study.

Though menu selections like these may sound far-fetched and futuristic, the foods they include are already available and could appear on a restaurant menu tomorrow if there were some guarantee that they would find acceptance among the dining public. (15)

As our population continues to increase, the problems associated with the food supply will also continue to increase. The pressures of these problems will certainly help launch searches for new and cheaper food sources. And technology will contribute by designing and fabricating radically new and different foods that can be delivered cheaply to consumers. Nor will the food service industry be immune to these pressures: Restaurants will increasingly add different, strange-sounding items to their menus. Some of them are appearing already: non-dairy creamer, imitation orange juice, soy extenders, and imitation bacon crisps, to name just four. Granted that these items have had a relatively minor impact on food service and its consumers so far; nevertheless, the future will bring dozens of new entree items like these to American menus.

But before this revolution in dining occurs, the food service industry will have to face the difficult question of new product acceptance. Why is it that the public readily accepts some new food products (like "textured potato chips") and rejects others (like "blend-o-beef" soy cum hamburger)? The krill, the chicken-flavored soy cubes, and the kelp, for example, are all available. But they are being withheld from the American market partly because their producers are uncertain of the reception they will meet.

## The Goals of This Study

In this study, the author intends to investigate the relationship between certain selected demographic factors and product perceptions among consumers, on the one hand, and innovative behavior among those consumers, on the other. My objective is to determine to what extent these characteristics can help explain the willingness of an individual to become an "innovator" by trying a new food product. My overall goal--that is, the reason for undertaking the study--is to develop possible strategies for the introduction of new food products in a food service setting. Thus, the food service implications of this study appear in a closing section entitled "The Role of Perception in the Development of Adoption Strategies for New Food Products in the Restaurant Industry."

If one can determine that the way a new food product is perceived by an individual substantially affects his purchasing behavior, one can outline marketing strategies that promise success in the 1980's and beyond. And armed with his marketing strategies, one can make concrete, realistic proposals that will, in fact, bring success. This study is, however exploratory, for no work dealing specifically with perceptions of new food products has been done. The only other major study in the area, "The Role of Product Perceptions in Innovative Behavior" by Lyman Ostlund, examined perceptions across six product categories. This study will replicate a portion of the Ostlund work, the portion that concentrated on the perceptual factor, and it will use some of Ostlund's questions to examine the perceptual characteristics of the subjects under consideration. In fact, this approach provides a means of testing the questions and comparing the results of the two studies. This area of Ostlund's work was chosen for study because it seemed the most promising in helping to explain innovative behavior as it affects the food service industry.

The author intends to measure willingness to innovate, rather than actual innovative behavior, because actual innovative behavior can be examined only by trusting consumers to remember products already on the market or by studying the adoption of new products by specific consumers over an extended period.

## The Diffusion of Innovation Theory

Research into new, non-food product acceptability has occurred in a number of disciplines. Marketing, for example has seen a large amount of research on new product acceptability, and the marketing approach has typically been to study the acceptability problem in the context of the Diffusion of Innovation Theory. This theory seeks to explain how innovation moves through a social system over a specific period, and why it moves the way it does. Research by marketers has shown that the rate of acceptance and movement of innovation through a social system is a function of these three characteristics:

1. The characteristics of the innovator,
2. The characteristics of the situation, and
3. The characteristics of the innovation.

Most of the research has dealt with the first set of characteristics, because the investigators tend to assume that certain demographic characteristics, or other personality or "life-style" characteristics, predispose people to try new products and eventually to adopt them. Examples of characteristics that might help explain new-product acceptance include age, income, "cosmopoliteness," education, and "venturesomeness." The investigators go on to assume that if some common characteristic of the innovator could be found to be decisive, a new product should be introduced into those markets where that characteristic predominates. The product would then have a better chance of acceptance and eventually of becoming diffused throughout the rest of the population. Unfortunately, the results of the

Table 1

## CONSUMER CHARACTERISTICS RELATED TO INNOVATIVENESS

Number of Empirical Findings Indicating Relation to Innovativeness (%)

| | Positive | None | Negative | Conditional | Total | Total Number of Published Findings |
|---|---|---|---|---|---|---|
| Sociodemographic | | | | | | |
| (1) Education | 74.6 | 16.1 | 5.2 | 4.1 | 100 | 193 |
| (2) Literacy | 70.4 | 22.2 | 3.7 | 3.7 | 100 | 27 |
| (3) Income | 80.3 | 10.7 | 6.3 | 2.7 | 100 | 112 |
| (4) Level of living | 82.5 | 10.0 | 2.5 | 5.0 | 100 | 40 |
| (5) Age | 32.3 | 40.5 | 17.7 | 9.5 | 100 | 158 |
| Attitudinal | | | | | | |
| (6) Knowledgeability | 78.8 | 16.7 | 1.5 | 3.0 | 100 | 66 |
| (7) Attitude toward change | 73.6 | 14.5 | 8.1 | 3.8 | 100 | 159 |
| (8) Achievement motivation | 64.7 | 23.5 | 0.0 | 11.8 | 100 | 17 |
| (9) Aspirations for children | 82.6 | 8.7 | 4.3 | 4.3 | 100 | 23 |
| (10) Business orientation | 60.0 | 20.0 | 20.0 | 0.0 | 100 | 5 |
| (11) Satisfaction with life | 28.6 | 28.6 | 42.8 | 0.0 | 100 | 7 |
| (12) Empathy | 75.0 | 0.0 | 25.0 | 0.0 | 100 | 4 |
| (13) Mental rigidity | 20.8 | 25.0 | 50.0 | 4.2 | 100 | 24 |

Adapted from James E. Engel, David T. Kollat, and Roger D. Blackwell, Consumer Behavior (New York: Holt, Rinehart and Winston, Inc., 1973).

marketing research described here have been mixed. Table 1 shows the result of a number of studies which looked, this way, at different kinds of innovator characteristics.

One can see that the second set of characteristics presents a situation in which a product is introduced to an individual in a population, and where the kinds of communications and promotional strategies used to make the individual aware of the new product and the reasons for his trial and adoption are subsequently analyzed. The results of the research in this area have also been spotty. But it has been found that the acceptance and diffusion of certain different kinds of innovations require certain kinds of information about, for example, price, packaging, and sales outlets.

The third set of characteristics, and the one that has received the least attention in marketing research, involves the characteristics of the product. Here we are interested in the characteristics of the innovation that the individual perceives and which then hinder or facilitate his trying and eventually adopting the product. Everett Rogers, a major contributor to diffusion research, has formulated what he believes to be the major characteristics of an innovation perceived by an individual. (29) Rogers believes that the extent to which these characteristics are perceived and how they are perceived will, to a large extent, determine whether an individual becomes an innovator. These characteristics include :

1. Relative Advantage--the degree to which an innovation is superior to the ideas it supplants (and these can be both economic and non-economic considerations);

2. Compatibility--the degree to which an innovation is consistent with the existing values and past experiences of the adopter (These

values and experiences would include norms, self-images, family influences and habits, or previously adopted ideas or products.);

3. Complexity--the degree to which an innovation is difficult to understand or use (the amount of learning involved in understanding the product and how it is used);

4. Divisibility (or Trialability)--the degree to which an innovation may be tried on a limited basis without a large commitment on the part of the individual (This would include both an economic and a non-economic commitment.); and

5. Communicability--the degree to which a product can be and is talked about in a social setting (These communications would include how a product is used and its advantages over the product it is meant to supplant.)

## The Hypotheses of This Study

In this study, the author uses three new food products, all of which will be described in detail shortly. All of the hypotheses will be tested for each of these products as well as collectively for their "product category." The hypotheses follow:

1. "Innovative Willingness" is a function of demographic factors and product perceptions. As such, it will vary positively with (a) the perceived Relative Advantage of the innovation, (b) directly with the perceived Compatibility of the innovation, (c) directly with the perceived Divisibility of the innovation, (d) directly with the perceived Communicability of the innovation, and (e) inversely with the perceived Complexity of the innovation.

2. "Innovative Willingness" varies (a) directly with the education of the respondent, (b) directly with family income, (c) directly with the age

of the respondent, and (d) inversely with the number of children in the respondent's household.

The first group of hypotheses are based on the sork of Rogers and Stanfield who summarized a group of previous studies and presented them in a table showing how perceptual characteristics vary with innovative willingness. (30) The Rogers and Stanfield chart appears as Table 2. The second group of hypotheses is based on the results of previous diffusion studies for a wide range of consumer products. All these variables indicated a strong correlation with innovative behavior for some studies.

## The Demographic Factors and Product Perception Dimensions to be Tested

The literature on the diffusion of innovations contains conflicting results for the same variables. This makes it difficult to draw comparisons between studies and to make statements about the relationships between variables. Perhaps the reason for this conflict is that there are different types of product innovations--in effect, different "degrees of newness"--and the confliction results may be caused by a comparison of one kind of innovation (or "newness") to a different kind of innovation (or "newness"). A classification scheme might be developed for different types of innovations and comparisons made only within the appropriate classifications. But to date, the schemes that have been developed are too general to be of much use, and none of them has contained enough information to calssify new innovations. One such classification scheme, based on the impact of the innovation on the individual and the social structure, was offered by Robertson.(27) In this system, quoted extensively in the marketing literature, innovations are classified as :

Table 2. How Perceptual Characteristics Vary with Innovative Willingness

| Characteristics of the Innovation | Number of Generalizations with Each Type of Relationship to Innovativeness (Percent) | | | | | Total Number of Generalizations |
|---|---|---|---|---|---|---|
| | Positive | None | Negative | Conditional | Total | |
| 1. Relative advantage | 79 | 15 | 3 | 3 | 100 | 63 |
| 2. Compatibility | 86 | 14 | 0 | 0 | 100 | 50 |
| 3. Fulfillment of felt needs | 92 | 4 | 4 | 0 | 100 | 27 |
| 4. Complexity | 19 | 37 | 44 | 0 | 100 | 16 |
| 5. Divisibility | 43 | 43 | 14 | 0 | 100 | 14 |
| 6. Communicability | 75 | 25 | 0 | 0 | 100 | 8 |
| 7. Availability | 56 | 22 | 17 | 5 | 100 | 18 |
| 8. Immediacy of bennefit | 57 | 29 | 14 | 0 | 100 | 7 |

Source: Everett M. Rogers and J. David Stanfield, "Adoption and Diffusion of New Products: Emerging Generalizations and Hypotheses," in F. M. Bass et al. (eds.) Application of the Sciences in Marketing Management (New York: John Wiley, 1968).

1. "Continuous." This kind of innovation has the least disrupting influence on established patterns. Alteration of an existing product is involved here rather than the establishment of a new product. Examples of a continuous innovation include flouride toothpaste, the annual automobile model changes, and menthol cigarettes.

2. "Dynamically Continuous." This kind of innovation has more disrupting effects than a continuous innovation, even though it does not generally alter established patterns. It may involve the creation of a new product or the alteration of an existing product. Examples of a dynamically continuous innovation include electric toothbrushes, the Mustang automobile, and touch-tone telephones.

3. "Discontinuous." This kind of innovation involves the establishment of a new product and the establishment of new behavior patterns. Examples of this innovation include television and computers.

The question of newness of important in helping to explain conflictint results in previous studies and perhaps in this study as well. As he will show later, the author attempted to choose food products for this study that fit into each of the preceding three categories. He hoped that any conflicting results that might appear between products for a given variable could be explained by the perception of newness. (as discussed later, this did happen for two of the dimensions studied.) Prior studies and other literature available suggest that the variable discussed in the next section is of particular interest to a study dealing with food.

## Education

Bylund, who did a major study on new food product innovation related to consumer demographics, found that "high triers" were better educated than "low triers." (6) More than twice as many housewives who were educated beyond the twelfth grade were among Bylund's "high trier" category than appeared among his "low triers." Of the 16 percent defined as "high triers," 84 percent had twelve or more years of schooling, in contrast to the "low triers" of whom only 48 percent had had that much schooling. The statistical relationship was also very strong. Bylund associated a similar "trying" pattern with the education of the husbands of those housewives.

In the classic "Colortown" study on innovation, early buyers of color television sets were also found to have achieved a relatively high level of education. (27) But Ostlund, who conducted research on innovative behavior among housewives, found that education bore no significant statistical relationship to innovative behavior for any of the six products he tested. (22) When he examined the products collectively, however, he found a statistically significant relationship that indicated that innovative willingness varied inversely with education. (Since 20 degrees of freedom were needed, however, one may question the validity of this relationship.)

King, who also studied consumer products, found early buyers of millinery to be well educated, but the relationship was not significant.(18) Feldman, who conducted research on innovation with the new "rotary-engine" Mazda automobile, found a collection of previous studies that suggested that durable goods innovators were generally well-educated, in "higher status" occupations, and had high incomes. Paradoxically, he found no support for these findings in the subsequent study he conducted involving the Mazda. (11)

One would expect education to correlate positively with innovative behavior among those products that differ significantly from the existing ones they are meant to replace. The better educated person ought to see the advantage of a new product quicker and should have less difficulty learning how to use it than the more poorly educated person. The products used in this study, though new, generally represented familiar commodities. But all of them had definable elements of uniqueness, especially for food products. Therefore the author expected that higher education would correlate positively with the Innovative Willingness demonstrated by the respondents in this study.

## Family Income

Family income has been shown to correlate positively with innovative behavior. Generally speaking, families with higher incomes are better educated, have had more varied experiences with new products, and are therefore more predisposed to a new experience than those with less disposable income. For high-income people, the risk associated with the initial trial is much less than for others. Rogers states that "earlier adopters have a more favorable financial position than later adopters. Affluence may be measured by high income, by a large-sized operation, or by the possession of wealth." (29) King, Robertson, and the "Colortown" study all found income correlated positively with innovative behavior. (18,25,27)

In his study of new food products, Byland found income to be directly related to the number of new food products tried. (6) In fact, low income appeared to limit experimentation with new foods. Predictably, the greatest reluctance was found among those with incomes below $3000. Only two percent of the "high trier" group fell in this range as compared with 21 percent of the "low trier" group.

But other studies have produced exceptions to this general finding. In a study of the early purchasers of Folger's coffee, Frank, Massy, and Morrison found that income ranked 18th out of 20 variables in its strength of correlation with innovative behavior. (14) Robertson and Rossiter found that for certain fashionable items of clothing, income did not exhibit a strong effect on innovation. (26) Feldman found the same in his study of Mazda innovators. (11)

Studying product perception, Ostlund found that "family income fails to yield a significantly strong relationship with innovative willingness for any of the six products or collectively across all products." (22)

Although Ostlund included no discussion, it may be that his findings are partly the result of small cell sizes and the fact that none of the items he studied were expensive and therefore the risk associated with making the "wrong" decision was low.

Even though results to the contrary appear in the literature, support still exists in enough abundance to suggest a positive correlation between income and innovative behavior, and the author hypothesized that this correlation would appear in this study.

## The Age of the Respondent

Commenting on age and innovative behavior, Rogers says, "The general evidence seems to indicate that innovators are younger than laggards. There are adequate theoretical grounds for expecting the younger members of a social system to be more innovative . . . the young [being] less conditioned by the older culture; hence more innovative." (29)

Robertson and Rossiter found that innovators of fashion among college girls were slightly younger than the non-innovators. (26) Bylund found that the age distributions of husbands and wives elicited similar results and that both very significantly affected the number of new foods tries. (At the over-55 age level, nobody was a "high trier.") (6) Ostlund found that a respondent's age varied directly with Innovative Willingness for three of the products he tested and displayed a clear relationship to the other three. (22)

But other research has produced contrary results. Arndt studied a new coffee product and found no significant relationship between the age of the respondent and innovative behavior. (1) Pessimer, Burger and Tigert found no relationship between age and innovative behavior for a new laundry detergent they studied. (25) And Frank, Massy and Morrison got the same results when they, too, studied a new coffee product. (14) Moreover, in his millinery study, King found innovators and early buyers to be slightly older than the laggards. (18)

A study by Progressive Grocer found "housewives over 45 more adventureous than their younger counterparts in trying some of the $10 billion worth of new grocery items placed before them each year." Among those over 45, 30 percent said they try a new product "right away", as opposed to 19 percent of the housewives under 25.

It would seem that the correlation between age and innovative behavior, if it exists, varies according to the product tested. But based on the Progressive Grocer study and the results of the Bylund study, both of which dealt with food products, the author hypothesizes that a respondent's age will vary directly with innovative behavior.

## Children in the Household

Obviously the number of people in a household plays a role in determining the innovative behavior of a respondent within certain food product categories. But the exact nature of this role is far from certain. In large families there is a greater chance that someone will like the food that is prepared, no matter what it may be, and therefore there may be greater encouragement for the housewife to try new food products. (On the other hand, the opposite effect--the increased assurance that someone will dislike the food--may also operate.) The author found only one study on food that addressed this variable directly. Bylund found a direct correlation between the size of the household and the number of new food products tried.(6) Bylund's most dramatic discovery in this area appeared in two-person households where he found only 11 percent of "high triers" as compared to 41 percent of the "low triers."

The author therefore hypothesized that the size of the household would vary directly with innovative behavior.

## A Discussion of the Rogers and Stanfield Summary, "Characteristics of Innovation"

The research into product perceptions and their effect on innovative behavior is both scanty and inconclusive. Originally formulated by Rogers within a rural sociology context, research theories of product perception can be transplanted into a consumer behavior context only with great uncertainty about whether thay can be operationalized correctly and whether evidence can be found to support them.

Rogers and Stanfield summarized the results of numerous empirical studies from different disciplines relating the characteristics of innovation to innovativeness or innovative behavior. Their findings have already appeared as Table 2. It should be pointed out that the generalizations noted on that table were not drawn from a consumer behavior context, and the methodology Rogers and Stanfield describe was not precisely the same as this study follows. Therefore the product opinions do not necessarily reflect those of the innovators and non-innovators in this study. They do, however, provide some support for the results achieved in the present study and, most particularly, for the methodology followed here.

### Relative Advantage

"Relative Advantage" refers to the degree to which an innovation is seen as superior to the product or idea it supersedes. To support his characteristic, Rogers provided evidence from rural sociology studies that suggest for farm innovations, anyway, Relative Advantage may be both economic and non-economic. The week spray, 2-4-D, was perceived by farmers to be an improvement (high Relative Advantage) over other forms of weed control mainly because it helped reduce unpleasant labor. Relative Advantage appears to have its greatest impact in times of crisis (when change is seen as most necessary) and in the presence of a strong promotional effort stressing the advantages of the new product to the user. Table 2 suggests that Relative Advantage exhibits a strong positive correlation with innovative behavior. Seventy-nine percent of the studies found a positive correlation as opposed to only 15 percent in which the correlation was negative. In the consumer context, Robertson defines and explains Relative Advantage this way:

> Relative Advantage is the degree to which an innovation is superior to the product it supersedes or with which it will compete. While the addition of fluoride to toothpaste yielded extra value in that product, many other ingredients had previously been added to toothpaste without the consumer attaching Relative Advantage to the resulting new product. An important marketing management function often is to create product differentiation in order to encourage the consumer to perceive greater value in one brand than in another. Perception of Relative Advantage is a factor encouraging the diffusion of a new product. (27)

Ostlund found that for all six products he tested, Relative Advantage related positively with Innovative Willingness at beyond the .001 level. (22) This was true both for products in which participants expressed a great deal of interest and for products that elicited less interest. In his study of Mazda purchasers, Feldman found that the new Mazda owners perceived greater Relative Advantage than purchasers of Toyotas, which were similar in every respect except for the rotary engine. (11)

Based on Rogers' formulations and the results of the limited research available, the author hypothesized that Relative Advantage would vary positively with Innovative Willingness.

## Compatibility

Rogers defined "Compatibility" as "the degree to which an innovation is consistent with existing values and the past experiences of the adopters." (29) As evidence of the importance of this dimension, he cites Graham's study on the acceptance of canasta by "upper class" New Haven residents versus the acceptance of television among "lower class" residents. The fact that the upper classes took more readily to canasta than the lower, and the lower classes to television more readily than the upper, Rogers felt, illustrates the importance of Compatibility between past experience or social norms, on the one hand, and the nature of the innovation, on the other. Within a consumer context, Robertson makes these remarks about Compatibility:

> Compatibility refers to how consistent the new product is with the existing ways to doing things. Television, for example, diffused more quickly at lower social class levels because it was more consistent with the lower class value system and way of life. The greater the need for the potential adopters to restructure their thinking and to engage in new forms of behavior, the less quickly the items will generally diffuse. (27)

Table 2 makes it apparent that Compatibility also exhibits a strong positive correlation with innovative behavior. Eighty-six percent of the studies show this positive correlation, 14 percent showed no relationship, and none showed a negative relationship.

Based on all available research, the author hypothesized that Compatibility would vary positively with Innovative Willingness.

Divisibility (or Trialability)

Rogers defined "Divisibility" as "the degree to which an innovation may be tried on a limited basis without a large commitment, either economic or non-economic on the part of the individual." (29) Then he cited the Ryan, Gross and Katz study of corn strains to show that Divisibility is perceived by early adopters as more important than by later adopters. (In this study, farmers resisted the adoption of a new strain of corn because they felt that they had to make too large a commitment to it.) Kivlin's study of farm practices found no significant correlation between Divisibility and adoption rate, but the relationship was positive.(20) Table 2 shows that research into Divisibility has produced mixed findings. Forty-three percent of the studies have shown a positive correlation, 14 percent a negative correlation, and 43 percent no correlation.

Robertson adopted this definition of Divisibility as appropriate to the consumer context:

> "Divisibility" refers to the extent to which a new product may be tried on a limited scale. In-store sampling of a new food product takes account of the Divisibility factor. Being able to purchase small packages of a new product may encourage diffusion. A related dimension might be "reversibility," how readily the innovation can be discontinued without disruption. It might be hypothesized that reversibility would correlate positively with rate of diffusion. (27)

Ostlund found that Divisibility related positively with Innovative Willingness for all six of his products beyond the .001 level and for all six products collectively. (22) Feldman found that Divisibility did not correlate with innovative behavior, but he felt that his research design may have adversely affected the results. (11) Therefore, the author hypothesized that Divisibility would vary positively with Innovative Willingness.

## Communicability

This characteristic was defined earlier as the degree to which results of an innovation may be communicated to others in a social setting. To demonstrate the importance of this characteristic, Rogers contrasted the Communicability of two farm innovations. Rogers found one group of farmers adopting pre-emergent weed killers slowly because they produced no visible dead weeds to assure the farmers and their neighbors that the chemical was actually working. On the other hand, illiterate Bolivian farmers readily adopted Cuban yellow corn because the new seed often tripled their yields. Table 2 shows the results of research in this area and supports Rogers' theory. Seventy-five percent of the studies show positive results, 25 percent show mixed results, and none show negative results.

Adapted to the consumer context, Robertson's description of "Communicability follows:

> [Communicability is] the degree to which word of a new product may be communicated readily to others. Conspicuous products such as clothes are highest in Communicability. It is necessary only to see the item for information to diffuse. Products which can be demonstrated to friends, such as a new cartridge stereo or television, are also high in Communicability.(27)

Ostlund found that for all six products he tested, Communicability related positively with innovative behavior at the .001 level. (22)

This was also true for all six products taken collectively. Feldman found that Communicability was no different for the Mazda innovator than for the Toyota innovator. (11) But to explain this, Feldman suggested that "while innovators perceive themselves as having greater understanding of the car they purchased, they also see themselves as having greater difficulty than buyers of a conventional car when it comes to communicating the features of the innovative product to others." Since Feldman's is the only conflicting study he could find, the author hypothesized that Communicability would relate positively with Innovative Willingness.

## Complexity

The final dimension, Complexity, has been defined as the degree to which an innovation is difficult to understand or use. In the study by Graham on the acceptance of canasta by upper class residents of New Haven and the acceptance of television among lower class residents of New Haven, the difference in understandibility between canasta and television (the two "pastimes") was seen as the major reason for explaining which group adopted which innovation.

In the consumer context, Robertson defines "Complexity" this way: "[Complexity is] the degree of difficulty in understanding and/or using the new product." (27) In general, the more complex an item, the slower its rate of diffusion and the narrower its potential market will be. Ostlund found that the Complexity dimension related negatively with Innovative Willingness for all six products he tested, taken individually and collectively. (22) Feldman also found that Complexity related negatively to Innovative Willingness. (11) Thus the author hypothesized that Complexity would vary inversely with Innovative Willingness.

## Research and Analysis Design

The following section presents the research and analysis design the author used to conduct this study. First, the products chosen for the test and the criteria used for their selection will be discussed. Second, the research setting used in the collection of the data will be described. Third, the questionnaire will be explained along with the rationale for the questions used. And fourth, the methods of analysis will be explained.

To repeat, there has been only minimal research, within a consumer context, on the relationship between product perceptions and innovative behavior. The only other major study was undertaken by Ostlund, and his results have already been discussed. Unfortunately, only one of the products Ostlund tested was a food item, so it is difficult to generalize his findings to the food product category. Nevertheless, the author decided to follow Ostlund's design as closely as possible for two reasons: First, an approximate replication would act as a check on Ostlund's results. (If the results for this study were the same as or similar to Ostlund's, it would add further evidence for and weight to his theories on the role and importance of product perceptions. (If significant differences in results emerge from a similar research design, one may be able to rule out the design and look for other causes.)

### The Products

The Introduction to this study stated the author's intention to explore the role of food product perceptions in innovative behavior and to investigate to what extent these variables help explain who will become an innovator. The problem with many earlier studies is that while they employed only a single product, the authors frequently felt free to generalize their findings to other product categories. Thus, when other researchers replicated the studies with different product categories, conflicting results often appeared. In other instances, researchers conducted studies with new products that varied only slightly from the existing products they were meant to replace. This tendency brings up the question of "newness," referred to earlier. (In fact, one could ask whether many of the "new" products should ever have been labeled as innovations.) Since no absolute standards exist for calling a product an innovation, there seems to be little that can be done short of providing an accurate description of the so-called innovation and its predecessor and allowing a reader to judge for himself.

The products used in this study were, in any case, selected with care, and only those that satisfied the following four criteria were accepted:

1. For use in this study, a product had to be in the test-market stage or in distribution outside the State College, Pennsylvania area. It was deemed important to use real products--not "product concepts"--in which manufacturers had invested time and money and which they expected to succeed.

2. Each product had to have, at least theoretically, a wide appeal and not be aimed at a narrow segment of the market.

3. Each product had to represent a degree of newness as postulated by Robertson's classification scheme for innovations in a consumer context. This was felt to be an important way to check the results for the effect the degree of innovation, or "newness," had on Innovative Willingness.

Thus the chicken au gratin was classified as a continuous innovation; the chicken hot dog was classified as a dynamically continuous innovation; and the Bontrae chicken textured vegetable protein dice was classified as a discontinuous innovation.

4. Each product had to be priced within the reach of a modest family food budget so that there would be no question of the wife's willingness to make a purchase without feeling compelled to consult her husband.

The products finally chosen are listed below with descriptions as furnished to the respondents and with some added descriptive material furnished by the author.

## Chicken au Gratin

> "Chicken au Gratin is a casserole of noodles combined with chunks of chicken mixed with a mild cheese sauce and topped with cheddar cheese. To prepare the item, you remove the film overwrap and place in a pre-heated 400-degree oven for one hour. Chicken au Gratin comes in a 2-pound package and sells for $2.19."

(Chicken au Gratin is what food service professionals call a "convenience" product. It is a casserole of wide noodles combined with chunks of chicken in a mild cheese sauce and topped with cheddar cheese. Its flavor and texture are reminiscent of macaroni and cheese. The product is manufactured by the Weaver Chicken Products Company of Lancaster, Pennsylvania, and it is sold retail.)

## Chicken Hot Dogs

> "Chicken hot dogs are a new kind of hot dog made completely with chicken. They look and taste like regular hot dogs. They

> come ten to a pound. A package of chicken hot dogs will sell for 99¢."

(Chicken hot dogs are an example of new food technology employed in the development of a new food product. An innovative process vibrates the normally unused small pieces of chicken from the necks and carcasses. The product that results is all chicken and can be formed into any number of different products. The chicken hot dog is one of them: It is flavored and shaped to taste and look like a beef hot dog. The chicken hot dogs are packaged and sold just like the beef product. This product is also manufactured by the Weaver Chicken Products Company. It is sold in both the institutional and the retail markets.)

### "Bontrae" Textured Vegetable Protein

> "Bontrae is a frozen textured vegetable protein product dice with a flavor like chicken. It is a fully cooked product and can be used alone or in combination with diced chicken meat in any standard chicken recipe. For example, to make chicken salad for four, you would combine one pound of Bontrae with four ounces of chopped celery, two ounces of mayonnaise, salt and pepper to taste, mix thoroughly, and allow to remain overnight in the refrigerator. Bontrae comes in a 5-pound package and must be kept frozen until ready for use. A package of Bontrae will sell for $4.20."

(Bontrae is the brand name of the textured vegetable protein product manufactured and distributed by General Mills. Bontrae is a spun soy product shaped to quarter-inch cubes. It is available in three different flavors--chicken, ham, and beef. Only the chicken flavor was used in this study. Bontrae comes in a five-pound package and must be kept frozen until used. At present, this product is available only in the institutional market.)

## The Research Setting and the Respondents

All of the field research for the study was conducted in two locations in the State College, Pennsylvania, areas. The author felt that a suitable number of subjects could be found without difficulty. The interview sessions were conducted once at each of the two locations. The first location was a classroom in the Pennsylvania State University's College of Human Development. This location provided a comfortable, accessible, central testing site for the first group of subjects. But to ensure a socio-economic mix of respondents, the author repeated the testing at a second location. He arranged to use the "community room" ( a large, empty, public room) at a local shopping mall.

At both locations, the three food products were arranged on separate tables in such a way that they could be easily inspected, but communication among subjects was hindered. At each location, the subjects entered the room and began by filling out the first section of a questionnaire, which dealt with demographic information. This part of the questionnaire was self-administered, and the respondents were asked to work alone and to refrain from communicating with anyone except the author's associates. After completing the demographic part of their questionnaires, the respondents were asked to go from table to table, to inspect each product carefully, and to answer a set of questions concerning each product. The typical respondent spent between 30 and 40 minutes completing the entire questionnaire.

A usable sample of 100 housewives was drawn from the area in and around State College so as to include a broad representation of ages, incomes, and family sizes. The criteria for selection were (1) that the person be married and (2) that he or she be responsible for the food shopping for a family unit. The author felt that a married individual would tend to consider more factors in food purchasing, and therefore if the product had any appeal at all, it would have to have a broader appeal. (To phrase it a different way, since the study recruited people who did the family shopping, a product that appealed only to the shopper would not necessarily be acceptable and get purchases.) The author also felt that a person who performed most of the shopping would, therefore, be in a better position to judge the new products on the perceptual dimensions listed previously.

To encourage participation, the author asked the subjects if they would help evaluate new food products that would be going on sale in the State College area within six months. Most of the subjects consented eagerly, seeing the experiment as both an adventure and an occasion where their expertise might be helpful. This reaction seems surprising in view of the standard marketing assumption that subjects will not cooperate with product research unless they receive some sort of remuneration. In this case, people were eager to participate free of charge.

Although the study concentrated only on the respondents' perceptions of the three food products, many respondents expressed a willingness, and even a need, to discuss their feelings and opinions about the products after they had completed their questionnaires. At this time, they were also allowed to taste the new products if they cared to.

## The Questionnaire

The author's questionnaire (which appears as Appendix A to this study) resembled the one devised by Ostlund in that the demographic questions were asked in the same way and the questions used to elicit the product perception dimensions were also the same. The questionnaire was divided into three parts. The first part elicited demographic information; the second part elicited product perceptions; and the third part measured a "willingness to innovate" for each of the three products. The demographic questions are standard, and it is not necessary to elaborate on them here. They appear, with the rest of the questionnaire, in Appendix A.

To measure the product perception dimensions, eleven questions were asked. Ostlund noted that his questions were developed as the result of several exploratory studies, and the questions in this study were, likewise, pre-tested by a small sample of housewives to ensure their reliability. The author encountered no problems and felt that this set of questions would be conducive to a practical and worthwhile study. Arranged according to the Rogers "Characteristic of Innovation" they measure, the questions follow here:

Relative Advantage. Two questions sought to measure this characteristic for each of the test products. The first question measured the value perceived in the product for its cost:

"Chicken au Gratin is worth every cent it costs."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

For this question and all the product perception questions, the respondent was asked to circle one of the six possible responses following the statement. The second question used to measure Relative Advantage was

> "Chicken au Gratin would offer real advantages over the way I presently do things."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

Compatibility. Rogers discussed Compatibility with respect of norms and values of the given social system, and he felt that those products that fit existing values and norms would be adopted quickest. Robertson added another dimension and, within a consumer context, discussed Compatibility in connection with habits or "present ways of doing things." Two questions in the present study sought to measure these components. The following question concentrated on norms and self-images:

> "Chicken au Gratin is not a product intended for a person like me."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

This question sought to measure Compatibility with respect to habits:

> "I would have to change some of the ways I do things if I used Chicken au Gratin."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

In addition to the components measured by these two questions, Ostlund found from an exploratory study that there was a third component of Compatibility. This component dealt with a husband's reaction to the purchase of a new product by his wife. During Ostlund's exploratory study, most of the participants expressed concern for their husband's preferences or attitudes toward the new product. To measure this additional Compatibility component, the author asked this question:

"My husband might object if I bought Chicken au Gratin."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

Complexity. The Complexity dimension has already been defined as the degree to which the product is difficult to understand or use. This dimension was measured by two questions. These questions did not measure separate components of the dimension, rather they explored two slightly different ways that the innovation might be viewed as complex. The two questions were

"I really don't understand how Chicken au Gratin is supposed to work."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree; and |

"I have no difficulty understanding how to use Chicken au Gratin."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

Divisibility. Divisibility refers to the degree to which an innovation may be tried on a limited basis without a large commitment to the product. In the consumer context, this is an awkward dimension to measure. Most large consumer purchases will be, after all, joint decisions involving both a husband and wife, and they are ordinarily characterized by large amounts of time and effort devoted to information acquisition. In a situation like this, Divisibility is low. In the food product category, however, decisions are often made exclusively by the shopper since foods are generally "low ticket" items. Consequently, Divisibility may be important and operative. On the other hand, there may be certain physical characteristics of the product, like its size or volume or packaging or display techniques, that hinder Divisibility.

If anindividual were forced to buy a large amount of the product and were afraid that he might not like it having bought it, he would be liable to resist it altogether. In addition, a "social cost" can operate to hinder Divisibility. If an individual thought he might be subject to ridicule or embarrassment by trying a new product, he would be almost certain to hesitate. This might happen in the case of a new food product with an uncertain taste or appearance; or the housewife might be unsure how to cook the product.

The questions designed to measure Divisibility in this study were phrased to account for the relatively low price of these three food products. These questions follow here:

> "I really wouldn't lose much if I bought Chicken au Gratin and it didn't work out the way I thought."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

> "I wouldn't have to spend very much to buy Chicken au Gratin in order to try it out."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

Communicability. Communicability refers to the degree to which results of an innovation may be communicated to others. There are probably two major components to this dimension. The first addresses the difficulty in describing a product and the results of using that product to others. This difficulty could arise from the complications of how the product works or how it is used. In the food product category, it may even refer to how the product tastes. If the Relative Advantage of the product is difficult to communicate, the innovation may diffuse through the social system with a great deal of difficulty. This slow diffusion may markedly affect innovation behavior for food products that normally would receive a strong push through word-of-mouth communication.

The second Communicability component refers to the fact that people talk about certain kinds of products and not about others. Certain products are, in fact, favorite conversation topics (detergents and various frozen or prepared foods, for example) while others are either uninteresting or socially unacceptable for conversation (like feminime hygiene products).

Food products are normally talked about, so we would expect the Communicability dimension to be important. There may, however, be food products that are actually embarrassing to discuss. Products that have a negative connotation or reflect adversely on social standing or economic well-being would fall into this category. One example is the early canned soybean meat substitute, which carried the image of "a poor people's food."

The first component of Communicability, the difficulty in describing the product, was measured by the following question:

> "I think if I bought and used Chicken au Gratin I would have no difficulty telling my friends what it was like.

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

The second Communicability component, whether the topic would be acceptable for conversation, was measured by the following question:

> "Chicken au Gratin is not the sort of product I would tell my friends about after I bought it."

| | | | | | |
|---|---|---|---|---|---|
| strongly agree | mainly agree | slightly agree | slightly disagree | mainly disagree | strongly disagree |

The Innovative Willingness Scale. The author decided to measure Innovative Willingness towards the three test products with a scale developed by F. Thomas Juster and used by him in various other consumer studies. (17) This scale allows a respondent to assign various probabilities to his intentions regarding the products. It provides 11 possible responses, allowing a subject some flexibility, Moreover, a statement appears with each numerical response describing what that response implies. This addition helps a respondent make his choice. This is what the Juster scale looks like:

> Please indicate by circling the appropriate response how likely you are to buy this product when it goes on sale in this area.

| | |
|---|---|
| Certain to buy | 10 |
| Almost sure to buy | 9 |
| Very probable that I'll buy | 8 |
| Probably buy | 7 |
| Good possibility of buying | 6 |
| Fairly good possibility of buying | 5 |
| Fair possibility of buying | 4 |
| Some possibility of buying | 3 |
| Slight possibility of buying | 2 |
| Very slight possibility of buying | 1 |
| No chance of buying | 0 |

## The Analysis Design

The analysis design for this study used sub-programs from the Statistical Packages for the Social Sciences (SPSS) a well-known series of programs used extensively in university research. Specifically, the author used cross tabulation (CROSSTABS) and multiple regression (REGRESSION) for correlating the independent variables, the demographic and perception measures, with the dependent variable, the Innovative Willingness score. This was done for each product and then for all products taken collectively. In addition, multiple regression equations, using a stepwise program were used to obtain, for each product and collectively over the three products, (1) net regression coefficients, (2) standard errors of these co-efficients, (3) the coefficients of multiple determination, and (4) appropriate F-ratios for the predictive variables in the regression equations.

The author also used CROSSTABS for the product perception variables. Responses from each of the components of a variable were analyzed separately and combined with other components of the same variable to achieve a total index for that variable. This index was then correlated with the Innovative Willingness Score for each of the products and then across all three products. This procedure of combining responses from individual questions for each product perception variable was followed for all the variables. The author also used multiple regression to explain the predictive ability of the perception variables relative to the demographic variables. The regression program employed a step-wise routine which added predictor variables in sequential fashion according to the largest amount of variance explained, as measured around the mean of the criterion, or dependent variable. Since the program provided the appropriate coefficients and ratios, variables could be dropped according to the desired levels of significance, and it was therefore possible to assess the relative importance of each independent variable in each multiple regression equation.

## Findings Concerning the Demographic Factors Related to Innovative Willingness

In this section, the author will report the relationships that he found to exist between the demographic factors studied and Innovative Willingness. For each factor, he will restate the hypothesis and then present the results. Tables that relate each of the factors to each product and collectively across all products appear in this section in order to depict the findings graphically.

To help a reader interpret the results of this study, the author points out that in the presentation of the CROSSTABS results for the demographics and, later on, for the product perception data, the row labeled "Innovative Willingness" refers to the probability of purchase response an individual made for that product. Those individuals who responded with a probability of purchase score of less than 30 were considered to be non-innovators; that is, they expressed a definite reluctance to purchase the product when it first comes on the market. Those who responded in the middle ranges--scores of between 30 and 70--were considered to be undecided, showing neither a strong predilection for or against the product. Those who scored 80 or higher were considered to be innovators; they expressed a positive commitment to purchase the product shortly after it comes on the market. For all products taken collectively, each respondent's score for each product was summed to provide a collective Innovative Willingness score.

Within each cell, the top number refers to the number of subjects who responded on that variable whose characteristics fit that cell. The lower number is the percentage of all individuals responding on that variable who are in that cell. The same holds true for the row and column totals.

## Education

The author hypothesized that education would correlate positively with Innovative Willingness, his thought being that the better educated a person is, the quicker he will see the benefits of a new product and the less difficulty he will have learning how it is used. But this hypothesis did not prove to be true for the education variable. Tables 3 through 6 indicate that the education of a respondent bears no statistical significant relationship to any of the three food products where Innovative Willingness is concerned. The author originally categorized the data into seven groups, but there were insufficient entries in some of the cells to make the results meaningful. Eventually they were collapsed into three groups, but the results remained not significant, even for Innovative Willingness collectively across all products.

## Family Income

The author hypothesized that family income would vary positively with Innovative Willingness. Those individuals with higher incomes, he supposed, would have had more experience with different foods and would see less economic and non-economic risk associated with trying out a new food product. To test this hypothesis, the author asked his respondents to indicate their 1974 family income by checking one of ten income categories. This distribution was related to Innovative Willingness for the three food products and disclosed no significant difference. Consequently, the income groups were collapsed to four groups. This collapsed version

### Table 3
### "Chicken au Gratin"
### Respondent Education

| | | Grades 1-12 | 1-2 yrs. College | 3+above yrs. College | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30 | 13 | 6 | 18 | 37 |
| | Non-Innovators | 13.4 | 6.2 | 18.6 | 38.1 |
| Innovative Willingness | 30-70 | 19 | 8 | 19 | 46 |
| | Undecideds | 19.6 | 8.2 | 19.6 | 47.4 |
| | 80 or Higher | 6 | 3 | 5 | 14 |
| | Innovators | 6.2 | 3.1 | 5.2 | 14.4 |
| | COLUMN | 38 | 17 | 42 | 97 |
| | TOTAL | 39.2 | 17.5 | 43.3 | 100.0 |

CHI SQUARE = 0.88702 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.9264

## Table 4

## "Chicken Hot Dogs"

## Respondent Education

| | | Grades 1-12 | 1-2 yrs. College | 3+above yrs. College | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Under 30 | 9 | 7 | 12 | 28 |
| | Non-Innovators | 9.3 | 7.2 | 12.4 | 28.9 |
| | 30-70 | 14 | 3 | 16 | 33 |
| | Undecideds | 14.4 | 3.1 | 16.5 | 34.0 |
| | 80 or Higher | 15 | 7 | 14 | 36 |
| | Innovators | 15.5 | 7.2 | 14.4 | 37.1 |
| | COLUMN | 38 | 17 | 42 | 97 |
| | TOTAL | 39.2 | 17.5 | 43.3 | 100.0 |

CHI SQUARE = 3.17514 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.5290

### Table 5

### "Bontrae"

### Respondent Education

| | | Grades 1-12 | 1-2 yrs. College | 3+above yrs. College | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30 | 28 | 13 | 26 | 67 |
| | Non-Innovators | 28.9 | 13.4 | 26.8 | 69.1 |
| Innovative | 30-70 | 5 | 3 | 9 | 17 |
| Willingness | Undecideds | 5.2 | 3.1 | 9.3 | 17.5 |
| | 80 or Higher | 5 | 1 | 7 | 13 |
| | Innovators | 5.2 | 1.0 | 7.2 | 13.4 |
| | COLUMN | 38 | 17 | 42 | 97 |
| | TOTAL | 39.2 | 17.5 | 43.3 | 100.0 |

CHI SQUARE = 2.39589 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.6634

### Table 6

### Collective

### Respondent Education

| | | Grades 1-12 | 1-2 yrs. College | 3+above yrs. College | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Low | 8<br>8.2 | 5<br>5.2 | 10<br>10.3 | 23<br>23.7 |
| | Medium | 20<br>20.6 | 9<br>9.3 | 22<br>22.7 | 51<br>52.6 |
| | High | 8<br>8.2 | 1<br>1.0 | 8<br>8.2 | 17<br>17.5 |
| | Highest | 2<br>2.1 | 2<br>2.1 | 2<br>2.1 | 6<br>6.2 |
| | COLUMN TOTAL | 38<br>39.2 | 17<br>17.5 | 42<br>43.3 | 97<br>100.0 |

CHI SQUARE = 3.03277 WITH 6 DEGREES OF FREEDOM

SIGNIFICANCE = 0.8047

appears on Tables 7 through 10. As can be seen on those tables, family income fails to yield a statistically significant relationship with respect to Innovative Willingness.

### The Age of the Respondent

The author's hypothesis for this variable was that Innovative Willingness would vary directly with the age of the respondent. This hypothesis had been borne out by recent research that dealt with food products. It was felt that the older shopper would be more experienced with food products and especially with evaluating and trying out new food products; therefore, one would find the direct relationship hypothesized. Respondents were asked to indicate their approximate ages by checking one of nine age categories in the questionnaire's demographic introduction. As with previous variables, these categories were collapsed to afford convenient interpretation. The results are shown on Tables 11 through 14. A significant relationship was found for the product Bontrae, the soybean dice flavored like chicken, but one could question this result on the basis of the extremely small cell sizes. The same result was found for the collective Innovative Willingness score for respondent age across all food products. Although the level of significance was .007, again the cell sized were very small.

### The Number of Children in the Household

The author hypothesized that Innovative Willingness would vary directly with the size of the household. He supposed, perhaps arbitrarily, that a high number of people in the home would act as a force for the trying of new food products. With a variety of tastes

## Table 7

## "Chicken au Gratin"

## Family Income ($000)

| | | Under 10 | 10-20 | 20-30 | Over 30 | ROW TOTAL |
|---|---|---|---|---|---|---|
| | Under 30 | 15 | 12 | 7 | 3 | 37 |
| | Non-Innovators | 15.5 | 12.4 | 7.2 | 3.1 | 38.1 |
| Innovative | 30-70 | 11 | 24 | 7 | 4 | 46 |
| Willingness | Undecideds | 11.3 | 24.7 | 7.2 | 4.1 | 47.4 |
| | 80 or Higher | 4 | 9 | 0 | 1 | 14 |
| | Innovators | 4.1 | 9.3 | 0.0 | 1.0 | 14.4 |
| | COLUMN | 30 | 45 | 14 | 8 | 97 |
| | TOTAL | 30.9 | 46.4 | 14.4 | 8.2 | 100.0 |

CHI SQUARE = 7.30329 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.2937

### Table 8

### "Chicken Hot Dogs"

### Family Income ($000)

| | | Under 10 | 10-20 | 20-30 | Over 30 | ROW TOTAL |
|---|---|---|---|---|---|---|
| Innovative Willingness | Under 30<br>Non-Innovators | 8<br>8.2 | 11<br>11.3 | 6<br>6.2 | 3<br>3.1 | 28<br>28.9 |
| | 30-70<br>Undecideds | 7<br>7.2 | 19<br>19.6 | 5<br>5.2 | 2<br>2.1 | 33<br>34.0 |
| | 80 or Higher<br>Innovators | 15<br>15.5 | 15<br>15.5 | 3<br>3.1 | 3<br>3.1 | 36<br>37.1 |
| | COLUMN<br>TOTAL | 30<br>30.9 | 45<br>46.4 | 14<br>14.4 | 8<br>8.2 | 97<br>100.0 |

CHI SQUARE = 6.05508 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.4170

## Table 9

"Bontrae"

Family Income ($000)

| | | Under 10 | 10-20 | 20-30 | Over 30 | ROW TOTAL |
|---|---|---|---|---|---|---|
| Innovative Willingness | Under 30 | 21 | 33 | 8 | 5 | 67 |
| | Non-Innovators | 21.6 | 34.0 | 8.2 | 5.2 | 69.1 |
| | 30-70 | 4 | 8 | 3 | 2 | 17 |
| | Undecideds | 4.1 | 8.2 | 3.1 | 2.1 | 17.5 |
| | 80 or Higher | 5 | 4 | 3 | 1 | 13 |
| | Innovators | 5.2 | 4.1 | 3.1 | 1.0 | 13.4 |
| | COLUMN | 30 | 45 | 14 | 8 | 97 |
| | TOTAL | 30.9 | 46.4 | 14.4 | 8.2 | 100.0 |

CHI SQUARE = 2.74001 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.8407

Table 10

Collective

Family Income ($000)

| | | Under 10 | 10-20 | 20-30 | Over 30 | ROW TOTAL |
|---|---|---|---|---|---|---|
| Innovative Willingness | Low | 7<br>7.2 | 10<br>10.3 | 2<br>2.1 | 4<br>4.1 | 23<br>23.7 |
| | Medium | 16<br>16.5 | 24<br>24.7 | 9<br>9.3 | 2<br>2.1 | 51<br>52.6 |
| | High | 4<br>4.1 | 9<br>9.3 | 3<br>3.1 | 1<br>1.0 | 17<br>17.5 |
| | Highest | 3<br>3.1 | 2<br>2.1 | 0<br>0.0 | 1<br>1.0 | 6<br>6.2 |
| | COLUMN TOTAL | 30<br>30.9 | 45<br>46.4 | 14<br>14.4 | 8<br>8.2 | 97<br>100.0 |

```
CHI SQUARE =      7.43337  WITH  9  DEGREES OF FREEDOM
SIGNIFICANCE =    0.5921
```

## Table 11

## "Chicken au Gratin"

## Respondent Age

| | | Under 30 | 31-40 | 41-50 | Above 51 | ROW TOTAL |
|---|---|---|---|---|---|---|
| Innovative Willingness | Under 30<br>Non-Innovators | 16<br>16.5 | 7<br>7.2 | 7<br>7.2 | 7<br>7.2 | 37<br>38.1 |
| | 30-70<br>Undecideds | 21<br>21.6 | 9<br>9.3 | 10<br>10.3 | 6<br>6.2 | 46<br>47.4 |
| | 80 or Higher<br>Innovators | 3<br>3.1 | 1<br>1.0 | 5<br>5.2 | 5<br>5.2 | 14<br>14.4 |
| | COLUMN TOTAL | 40<br>41.2 | 17<br>17.5 | 22<br>22.7 | 18<br>18.6 | 97<br>100.0 |

CHI SQUARE = 6.87146 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.3329

Table 12

"Chicken Hot Dogs"

Respondent Age

| | | Under 30 | 31-40 | 41-50 | Above 51 | ROW TOTAL |
|---|---|---|---|---|---|---|
| | Under 30 | 17 | 3 | 4 | 4 | 28 |
| | Non-Innovators | 17.5 | 3.1 | 4.1 | 4.1 | 28.9 |
| Innovative | 30-70 | 14 | 7 | 8 | 4 | 33 |
| Willingness | Undecided | 14.4 | 7.2 | 8.2 | 4.1 | 34.0 |
| | 80 or Higher | 9 | 7 | 10 | 10 | 36 |
| | Innovators | 9.3 | 7.2 | 10.3 | 10.3 | 37.1 |
| | COLUMN | 40 | 17 | 22 | 18 | 97 |
| | TOTAL | 41.2 | 17.5 | 22.7 | 18.6 | 100.0 |

CHI SQUARE = 9.94069 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.1272

## Table 13
## "Bontrae"
## Respondent Age

| | | Under 30 | 31-40 | 41-50 | Above 51 | ROW TOTAL |
|---|---|---|---|---|---|---|
| | Under 30 | 30 | 16 | 14 | 7 | 67 |
| | Non-Innovators | 30.9 | 16.5 | 14.4 | 7.2 | 69.1 |
| Innovative Willingness | 30-70 | 6 | 1 | 7 | 3 | 17 |
| | Undecideds | 6.2 | 1.0 | 7.2 | 3.1 | 17.5 |
| | 80 or Higher | 4 | 0 | 1 | 8 | 13 |
| | Innovators | 4.1 | 0.0 | 1.0 | 8.2 | 13.4 |
| | COLUMN | 40 | 17 | 22 | 18 | 97 |
| | TOTAL | 41.2 | 17.5 | 22.7 | 18.6 | 100.0 |

CHI SQUARE = 25.10168 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0003

### Table 14

### Collective

### Respondent Age

| | | Under 30 | 31-40 | 41-50 | Above 51 | ROW TOTAL |
|---|---|---|---|---|---|---|
| Innovative Willingness | Low | 14<br>14.4 | 4<br>4.1 | 3<br>3.1 | 3<br>3.1 | 24<br>24.7 |
| | Medium | 21<br>21.6 | 12<br>12.4 | 12<br>12.4 | 5<br>5.2 | 50<br>51.5 |
| | High | 5<br>5.2 | 1<br>1.0 | 5<br>5.2 | 6<br>6.2 | 17<br>17.5 |
| | Highest | 0<br>0.0 | 0<br>0.0 | 2<br>2.1 | 4<br>4.1 | 6<br>6.2 |
| | COLUMN TOTAL | 40<br>41.2 | 17<br>17.5 | 22<br>22.7 | 18<br>18.6 | 97<br>100.0 |

CHI SQUARE = 22.60370 WITH 9 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0072

to please, a shopper would be likely to try something new that someone in the family might like. As shown on Tables 15 through 18, Innovative Willingness for chicken hot dogs and for Bontrae appeared to vary positively with the size of the household. One can question the results obtained with the Bontrae, since the cell sizes were small. Nonetheless, as the results were significant, the findings here support the findings of Bylund. These results may possibly be explained by the fact that a large family presents as many opportunities for food acceptance as food rejection, and furthermore, any time or labor saving advantages offered by the new product would be quickly appreciated by the shopper. In other words, the shopper may see chicken hot dogs as offering everything her present brand offers and, for example, at a lower price, or with a greater ease of preparation, or at a higher return nutritionally. Moreover, with the large family, the shopper has more of an opportunity to try the new product. He could move easily into the trial stage of the adoption process by trying the new product out on just a few of the more compliant family members. This same line of reasoning would apply to the Bontrae product.

From the results of the relationship between demographic factors and Innovative Willingness, it can be concluded only that these demographic variables are relatively weak predictors of Innovatiove Willingness for the food products category. This conclusion is consistent with the general findings of other researchers who have attempted to find a relationship between innovative behavior and various demographic characteristics. Although a large amount of research effort has been spent in this area, the findings at hand support the idea that the ability to predict innovative behavior can not be found by searching for the "right" demographic characteristics.

## Table 15

## "Chicken au Gratin"

## Number of Children in Household

| | | No Children | One Child | Two Children | Three Children | 4-5 Children | ROW TOTAL |
|---|---|---|---|---|---|---|---|
| Innovative Willingness | Under 30 | 18 | 2 | 10 | 5 | 2 | 37 |
| | Non-Innovators | 18.6 | 2.1 | 10.3 | 5.2 | 2.1 | 38.1 |
| | 30-70 | 19 | 9 | 7 | 9 | 2 | 46 |
| | Undecideds | 19.6 | 9.3 | 7.2 | 9.3 | 2.1 | 47.4 |
| | 80 or Higher | 4 | 2 | 2 | 3 | 3 | 14 |
| | Innovators | 4.1 | 2.1 | 2.1 | 3.1 | 3.1 | 14.4 |
| | COLUMN | 41 | 13 | 19 | 17 | 7 | 97 |
| | TOTAL | 42.3 | 13.4 | 19.6 | 17.5 | 7.2 | 100.0 |

CHI SQUARE = 10.94194 WITH 8 DEGREES OF FREEDOM
SIGNIFICANCE = 0.2050

## Table 16

## "Chicken Hot Dogs"

## Number of Children in Household

| | | No Children | One Child | Two Children | Three Children | 4-5 Children | ROW TOTAL |
|---|---|---|---|---|---|---|---|
| Innovative Willingness | Under 30 | 17 | 2 | 3 | 6 | 0 | 28 |
| | Non-Innovators | 17.5 | 2.1 | 3.1 | 6.2 | 0.0 | 28.9 |
| | 30-70 | 12 | 8 | 6 | 3 | 4 | 33 |
| | Undecideds | 12.4 | 8.2 | 6.2 | 3.1 | 4.1 | 34.0 |
| | 80 or Higher | 12 | 3 | 10 | 8 | 3 | 36 |
| | Innovators | 12.4 | 3.1 | 10.3 | 8.2 | 3.1 | 37.1 |
| | COLUMN | 41 | 13 | 19 | 17 | 7 | 97 |
| | TOTAL | 42.3 | 13.4 | 19.6 | 17.5 | 7.2 | 100.0 |

CHI SQUARE = 15.21892 WITH 8 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0550

## Table 17

## "Bontrae"

## Number of Children in Household

|  |  | No Children | One Child | Two Children | Three Children | 4-5 Children | ROW TOTAL |
|---|---|---|---|---|---|---|---|
| Innovative Willingness | Under 30 Non-Innovators | 31<br>32.0 | 12<br>12.4 | 9<br>9.3 | 13<br>13.4 | 2<br>2.1 | 67<br>69.1 |
|  | 30-70 Undecideds | 6<br>6.2 | 0<br>0.0 | 4<br>4.1 | 4<br>4.1 | 3<br>3.1 | 17<br>17.5 |
|  | 80 or Higher Innovators | 4<br>4.1 | 1<br>1.0 | 6<br>6.2 | 0<br>0.0 | 2<br>2.1 | 13<br>13.4 |
|  | COLUMN TOTAL | 41<br>42.3 | 13<br>13.4 | 19<br>19.6 | 17<br>17.5 | 7<br>7.2 | 97<br>100.0 |

CHI SQUARE = 18.77115 WITH 8 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0161

### Table 18

### Collective

### Number of Children in Household

| | | No Children | One Child | Two Children | Three Children | 4-5 Children | ROW TOTAL |
|---|---|---|---|---|---|---|---|
| Innovative Willingness | Low | 14<br>14.4 | 2<br>2.1 | 2<br>2.1 | 4<br>4.1 | 1<br>1.0 | 23<br>23.7 |
| | Medium | 21<br>21.6 | 10<br>10.3 | 10<br>10.3 | 9<br>9.3 | 1<br>1.0 | 51<br>52.6 |
| | High | 5<br>5.2 | 0<br>0.0 | 5<br>5.2 | 3<br>3.1 | 4<br>4.1 | 17<br>17.5 |
| | Highest | 1<br>1.0 | 1<br>1.0 | 2<br>2.1 | 1<br>1.0 | 1<br>1.0 | 6<br>6.2 |
| | COLUMN TOTAL | 41<br>42.3 | 13<br>13.4 | 19<br>19.6 | 17<br>17.5 | 7<br>7.2 | 97<br>100.0 |

CHI SQUARE = 19.70255 WITH 12 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0729

## Findings Concerning the Product Perception Factors

The results of the product perception dimension are clearer than for those obtained with the demographic factors. In fact, almost all of the product perception dimensions appear to relate significantly with Innovative Willingness, in accordance with the hypotheses set forth earlier. In the following section, the tables presented relate Innovative Willingness for each product to each product perception dimension. Tables will not be shown for each specific question used as a component of a perception dimension. Rather the questions have been summed, and only the total dimension appears.

### Relative Advantage

For all three food products, the Relative Advantage dimension related positively with Innovative Willingness at beyond the .001 level of significance. This was true for the chicken hot dogs, for which there was high purchase interest, as well as for the Bontrae, in which there was substantially less purchase interest. Tables 19 through 22 show the relationships found. To find the collective Innovative Willingness relationship, the author summed the responses to the Relative Advantage questions from all three products together with the responses concerning Innovative Willingness. This summation also produced a significant relationship beyond the .001 level.

### Compatibility

The Compatibility dimension contained three components: norms and values, habits, and compatibility with husbands' preferences. For the chicken hot dogs and the chicken au gratin, Compatibility was found to

Table 19

"Chicken au Gratin"

Relative Advantage

|  |  | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Under 30<br>Non-Innovators | 0<br>0.0 | 10<br>10.3 | 26<br>26.8 | 36<br>37.1 |
|  | 30-70<br>Undecideds | 3<br>3.1 | 33<br>34.0 | 11<br>11.3 | 47<br>48.5 |
|  | 80 or Higher<br>Innovators | 6<br>6.2 | 8<br>8.2 | 0<br>0.0 | 14<br>14.4 |
|  | COLUMN TOTAL | 9<br>9.3 | 51<br>52.6 | 37<br>38.1 | 97<br>100.0 |

CHI SQUARE = 46.80232 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0000

### Table 20

### "Chicken Hot Dogs"

### Relative Advantage

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30 Non-Innovators | 2<br>2.1 | 7<br>7.2 | 19<br>19.6 | 28<br>28.9 |
| Innovative Willingness | 30-70 Undecideds | 1<br>1.0 | 23<br>23.7 | 9<br>9.3 | 33<br>34.0 |
| | 80 or Higher Innovators | 10<br>10.3 | 24<br>24.7 | 2<br>2.1 | 36<br>37.1 |
| | COLUMN TOTAL | 13<br>13.4 | 54<br>55.7 | 30<br>30.9 | 97<br>100.0 |

CHI SQUARE = 35.68045 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0000

### Table 21
### "Bontrae"
### Relative Advantage

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Under 30<br>Non-Innovators | 2<br>2.1 | 18<br>18.6 | 45<br>46.4 | 65<br>67.0 |
| | 30-70<br>Undecideds | 2<br>2.1 | 13<br>13.4 | 4<br>4.1 | 19<br>19.6 |
| | 80 or Higher<br>Innovators | 7<br>7.2 | 6<br>6.2 | 0<br>0.0 | 13<br>13.4 |
| | COLUMN<br>TOTAL | 11<br>11.3 | 37<br>38.1 | 49<br>50.5 | 97<br>100.0 |

CHI SQUARE = 45.62207 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0000

### Table 22

### Collective

### Relative Advantage

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Low | 0 | 6 | 17 | 23 |
| | | 0.0 | 6.2 | 17.5 | 23.7 |
| | Medium | 0 | 28 | 23 | 51 |
| | | 0.0 | 28.9 | 23.7 | 52.6 |
| | High | 0 | 17 | 0 | 17 |
| | | 0.0 | 17.5 | 0.0 | 17.5 |
| | Highest | 3 | 3 | 0 | 6 |
| | | 3.1 | 3.1 | 0.0 | 6.2 |
| | COLUMN TOTAL | 3 | 54 | 40 | 97 |
| | | 3.1 | 55.7 | 41.2 | 100.0 |

CHI SQUARE = 70.78075 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0000

relate positively with Innovative Willingness at beyond the .001 level of significance. This finding is displayed in Tables 23 and 24. For Bontrae, however, no correlation at a significant level appeared (on Table 25), and it may be worth speculating why this was so. The author sees two possible explanations: First, most respondents did not seem to see Bontrae as a compatible product. Only 29 percent of the respondents scored this product high along this dimension. Second, there may have been a component of Compatibility with respect to food products present but unmeasured in this study. Support for this speculation appears in the number of respondents who scored this product high but revealed a low purchase probability. For the collective relationship of Compatibility with Innovative Willingness (Table 26), no statistically significant relationship appeared.

### Divisibility (Trialability)

The third product perception dimension, Divisibility, was found to relate positively with Innovative Willingness for each product and for all products taken collectively. In all cases, the level of significance was beyond .001. The results appear in Tables 27 through 30.

### Complexity

The author hypothesized that Complexity would relate inversely with Innovative Willingness for all products. On Tables 31 through 34 it can be seen that this was not the case. No significant relationship was found for the chicken hot dogs and the chicken au gratin. The results for the Bontrae soy product, however, were more interesting. Here the relationship was significant at the .07 level. This finding

## Table 23

## "Chicken au Gratin"

## Compatibility

| | | Low | Medium | High | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30 | 7 | 23 | 6 | 36 |
| | Non-Innovators | 7.2 | 23.7 | 6.2 | 37.1 |
| Innovative | 30-70 | 1 | 28 | 18 | 47 |
| Willingness | Undecideds | 1.0 | 28.9 | 18.6 | 48.5 |
| | 80 or Higher | 1 | 6 | 7 | 14 |
| | Innovators | 1.0 | 6.2 | 7.2 | 14.4 |
| | COLUMN | 9 | 57 | 31 | 97 |
| | TOTAL | 9.3 | 58.8 | 32.0 | 100.0 |

CHI SQUARE = 12.08889 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0167

### Table 24

### "Chicken Hot Dogs"

### Compatibility

| | | Low | Medium | High | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30 | 8 | 12 | 8 | 28 |
| | Non-Innovators | 8.2 | 12.4 | 8.2 | 28.9 |
| Innovative | 30-70 | 2 | 12 | 19 | 33 |
| Willingness | Undecideds | 2.1 | 12.4 | 19.6 | 34.0 |
| | 80 or Higher | 1 | 9 | 26 | 36 |
| | Innovators | 1.0 | 9.3 | 26.8 | 37.1 |
| | COLUMN | 11 | 33 | 53 | 97 |
| | TOTAL | 11.3 | 34.0 | 54.6 | 100.0 |

CHI SQUARE = 17.59795 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0015

## Table 25

## "Bontrae"

## Compatibility

| | | Low | Medium | High | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30 | 3 | 44 | 18 | 65 |
| | Non-Innovators | 3.1 | 45.4 | 18.6 | 67.0 |
| Innovative Willingness | 30-70 | 0 | 13 | 6 | 19 |
| | Undecideds | 0.0 | 13.4 | 6.2 | 19.6 |
| | 80 or Higher | 1 | 8 | 4 | 13 |
| | Innovators | 1.0 | 8.2 | 4.1 | 13.4 |
| | COLUMN | 4 | 65 | 28 | 97 |
| | TOTAL | 4.1 | 67.0 | 28.9 | 100.0 |

CHI SQUARE = 1.38709 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.8464

Table 26

Collective

Compatibility

| | | Low | Medium | High | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Low | 2<br>2.1 | 17<br>17.5 | 4<br>4.1 | 23<br>23.7 |
| | Medium | 1<br>1.0 | 31<br>32.0 | 19<br>19.6 | 51<br>52.6 |
| | High | 1<br>1.0 | 7<br>7.2 | 9<br>9.3 | 17<br>17.5 |
| | Highest | 0<br>0.0 | 4<br>4.1 | 2<br>2.1 | 6<br>6.2 |
| | COLUMN TOTAL | 4<br>4.1 | 59<br>60.8 | 34<br>35.1 | 97<br>100.0 |

CHI SQUARE = 7.55416 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.2726

## Table 27

## "Chicken au Gratin"

## Trialability

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30 | 0 | 15 | 21 | 36 |
| | Non-Innovators | 0.0 | 15.5 | 21.6 | 37.1 |
| Innovative Willingness | 30-70 | 4 | 28 | 15 | 47 |
| | Undecideds | 4.1 | 28.9 | 15.5 | 48.5 |
| | 80 or Higher | 6 | 5 | 3 | 14 |
| | Innovators | 6.2 | 5.2 | 3.1 | 14.4 |
| | COLUMN | 10 | 48 | 39 | 97 |
| | TOTAL | 10.3 | 49.5 | 40.2 | 100.0 |

CHI SQUARE = 25.16656 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0000

## Table 28

## "Chicken Hot Dogs"

## Trialability

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Under 30<br>Non-Innovators | 5<br>5.2 | 15<br>15.5 | 8<br>8.2 | 28<br>28.9 |
| | 30-70<br>Undecideds | 14<br>14.4 | 18<br>18.6 | 1<br>1.0 | 33<br>34.0 |
| | 80 or Higher<br>Innovators | 21<br>21.6 | 14<br>14.4 | 1<br>1.0 | 36<br>37.1 |
| | COLUMN<br>TOTAL | 40<br>41.2 | 47<br>48.5 | 10<br>10.3 | 97<br>100.0 |

CHI SQUARE = 20.09306 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0005

Table 29

"Bontrae"

Trialability

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Under 30 Non-Innovators | 2<br>2.1 | 10<br>10.3 | 53<br>54.6 | 65<br>67.0 |
| | 30-70 Undecideds | 4<br>4.1 | 7<br>7.2 | 8<br>8.2 | 19<br>19.6 |
| | 80 or Higher Innovators | 8<br>8.2 | 4<br>4.1 | 1<br>1.0 | 13<br>13.4 |
| | COLUMN TOTAL | 14<br>14.4 | 21<br>21.6 | 62<br>63.9 | 97<br>100.0 |

CHI SQUARE = 41.07576 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0000

### Table 30

### Collective

### Trialability

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Low | 0<br>0.0 | 9<br>9.3 | 14<br>14.4 | 23<br>23.7 |
| | Medium | 1<br>1.0 | 26<br>26.8 | 24<br>24.7 | 51<br>52.6 |
| | High | 1<br>1.0 | 15<br>15.5 | 1<br>1.0 | 17<br>17.5 |
| | Highest | 4<br>4.1 | 2<br>2.1 | 0<br>0.0 | 6<br>6.2 |
| | COLUMN TOTAL | 6<br>6.2 | 52<br>53.6 | 39<br>40.2 | 97<br>100.0 |

CHI SQUARE = 54.03835 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0000

## Table 31

## "Chicken au Gratin"

## Complexity

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30<br>Non-Innovators | 1<br>1.0 | 5<br>5.2 | 30<br>30.9 | 36<br>37.1 |
| Innovative Willingness | 30-70<br>Undecideds | 1<br>1.0 | 8<br>8.2 | 38<br>39.2 | 47<br>48.5 |
| | 80 or Higher<br>Innovators | 0<br>0.0 | 1<br>1.0 | 13<br>13.4 | 14<br>14.4 |
| | COLUMN TOTAL | 2<br>2.1 | 14<br>14.4 | 81<br>83.5 | 97<br>100.0 |

CHI SQUARE = 1.30660 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.8603

### Table 32
### "Chicken Hot Dogs"
### Complexity

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| | Under 30 | 3 | 8 | 17 | 28 |
| | Non-Innovators | 3.1 | 8.2 | 17.5 | 28.9 |
| Innovative Willingness | 30-70 | 2 | 11 | 20 | 33 |
| | Undecideds | 2.1 | 11.3 | 20.6 | 34.0 |
| | 80 or Higher | 1 | 14 | 21 | 36 |
| | Innovators | 1.0 | 14.4 | 21.6 | 37.1 |
| | COLUMN TOTAL | 6 | 33 | 58 | 97 |
| | | 6.2 | 34.0 | 59.8 | 100.0 |

CHI SQUARE = 2.12531 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.7127

Table 33

"Bontrae"

Complexity

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative | Under 30 | 3 | 32 | 30 | 65 |
| | Non-Innovators | 3.1 | 33.0 | 30.9 | 67.0 |
| | 30-70 | 2 | 6 | 11 | 19 |
| | Undecideds | 2.1 | 6.2 | 11.3 | 19.6 |
| | 80 or Higher | 0 | 2 | 11 | 13 |
| | Innovators | 0.0 | 2.1 | 11.3 | 13.4 |
| | COLUMN | 5 | 40 | 52 | 97 |
| | TOTAL | 5.2 | 41.2 | 53.6 | 100.0 |

CHI SQUARE = 8.38471 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0785

Table 34

Collective

Complexity

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Low | 1<br>1.0 | 6<br>6.2 | 16<br>16.5 | 23<br>23.7 |
| | Medium | 0<br>0.0 | 10<br>10.3 | 41<br>42.3 | 51<br>52.6 |
| | High | 0<br>0.0 | 4<br>4.1 | 13<br>13.4 | 17<br>17.5 |
| | Highest | 0<br>0.0 | 0<br>0.0 | 6<br>6.2 | 6<br>6.2 |
| | COLUMN TOTAL | 1<br>1.0 | 20<br>20.6 | 76<br>78.4 | 97<br>100.0 |

CHI SQUARE = 5.50349 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.4810

seems to contradict the notion that either all or none of the three food products would be significantly related to Innovative Willingness within this dimension until one realizes that the soy product was the only food that had any complexity associated with its understanding or use. Bontrae requires a consumer's time and effort before he learns how to use it. It would appear that Complexity as a perceptual dimension, then, operates only for those new food products that require a significant amount of learning before they can be understood and used. Robertson referred to these kinds of products as "discontinuous."

For the collective relationship, no statistical significance was found.

### Communicability

The author's hypothesis was that Communicability would vary positively with Innovative Willingness for all products. For all products, taken both individually and collectively, this proved to be the case. The results appear on Tables 35 through 38. Again, the significance in all cases extends beyond the .001 level.

The strong relationship found between most of the product perception dimensions and Innovative Willingness supports the predictive capability forecast at the beginning of this research. These results stand in sharp contrast to those found for the demographic variables. In those instances where the hypotheses were not supported, it would appear that other factors were operating. It may be that there are other dimensions of importance for different product categories that were not tested in this study. This is, in fact, a reasonable explanation for the poor results with the Bontrae soy product within the Compatibility dimension.

### Table 35

### "Chicken au Gratin"

### Communicability

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Under 30<br>Non-Innovators | 15<br>15.5 | 16<br>16.5 | 5<br>5.2 | 36<br>37.1 |
| | 30-70<br>Undecideds | 26<br>26.8 | 20<br>20.6 | 1<br>1.0 | 47<br>48.5 |
| | 80 or Higher<br>Innovators | 12<br>12.4 | 2<br>2.1 | 0<br>0.0 | 14<br>14.4 |
| | COLUMN TOTAL | 53<br>54.6 | 38<br>39.2 | 6<br>6.2 | 97<br>100.0 |

CHI SQUARE = 11.76375 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0192

## Table 36

## "Chicken Hot Dogs"

## Communicability

|  |  | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Under 30<br>Non-Innovators | 7<br>7.2 | 15<br>15.5 | 6<br>6.2 | 28<br>28.9 |
|  | 30-70<br>Undecideds | 14<br>14.4 | 18<br>18.6 | 1<br>1.0 | 33<br>34.0 |
|  | 80 or Higher<br>Innovators | 25<br>25.8 | 10<br>10.3 | 1<br>1.0 | 36<br>37.1 |
|  | COLUMN<br>TOTAL | 46<br>47.4 | 43<br>44.3 | 8<br>8.2 | 97<br>100.0 |

CHI SQUARE = 18.65860 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0009

## Table 37

"Bontrae"

Communicability

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Under 30 | 28 | 26 | 11 | 65 |
| | Non-Innovators | 28.9 | 26.8 | 11.3 | 67.0 |
| | 30-70 | 10 | 9 | 0 | 19 |
| | Undecideds | 10.3 | 9.3 | 0.0 | 19.6 |
| | 80 or Higher | 13 | 0 | 0 | 13 |
| | Innovators | 13.4 | 0.0 | 0.0 | 13.4 |
| | COLUMN | 51 | 35 | 11 | 97 |
| | TOTAL | 52.6 | 36.1 | 11.3 | 100.0 |

CHI SQUARE = 17.72963 WITH 4 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0014

### Table 38

Collective
Communicability

| | | High | Medium | Low | ROW TOTAL |
|---|---|---|---|---|---|
| Innovative Willingness | Low | 4 | 12 | 7 | 23 |
| | | 4.1 | 12.4 | 7.2 | 23.7 |
| | Medium | 19 | 30 | 2 | 51 |
| | | 19.6 | 30.9 | 2.1 | 52.6 |
| | High | 6 | 11 | 0 | 17 |
| | | 6.2 | 11.3 | 0.0 | 17.5 |
| | Highest | 5 | 1 | 0 | 6 |
| | | 5.2 | 1.0 | 0.0 | 6.2 |
| | COLUMN TOTAL | 34 | 54 | 9 | 97 |
| | | 35.1 | 55.7 | 9.3 | 100.0 |

CHI SQUARE = 22.94493 WITH 6 DEGREES OF FREEDOM
SIGNIFICANCE = 0.0008

It may also be that the "newness" of a product, to use the classification suggested by Robertson, affects its perception. Complexity seemed to operate only for the product that was, in fact, difficult to understand and use. If one assumes that all dimensions operate equally and have the same impact on respondents, one will be disappointed. For different product categories, different dimensions seem to be more important than others. It may be that these dimensions stand out and the others operate only if they detract from the product. Thus, the chicken hot dogs and the chicken au gratin show no relationship with Complexity because the dimension does not operate for these products. It operates only for the soy product because it has a negative impact.

Obviously what the author suggests is speculation. Further research should test these ideas. But the exciting thing here is that these dimensions appear to be important, and that fact opens new possibilities for understanding and explaining the phenomenon of new product adoption. In the food product category, it is even more important because so many products are sure to be introduced in the future.

In the next section, the author will examine the relative predictive value of all the primary independent variables through the use of multiple regression. And in the section after that, he presents a model of product adoption and suggests how the tested perceptual dimensions help adoption.

## Multiple Regression Results

It should now be clear that the relationship between the product perception dimensions and innovative behavior is much closer than the relationship between demographic factors and innovative behavior. This section explores the predictive ability of the independent variables to

Innovative Willingness, for it is predictive ability that can lead to new strategies for the introduction of new food products.

To determine this predictive ability, the author used a step-wise multiple regression program. This program initially computes the correlation coefficients for all of the variables. The variable with the largest coefficient enters the program in the first step. Then the $R^2$ (the coefficient of multiple determination) is computed. Holding this first variable constant, one can compute the partial correlation coefficients for the remaining variables.

In the second step, the variable with the largest partial correlation coefficient enters the equation, and the $R^2$ is computed. Holding the two variables now in the equation constant, one can compute the partial correlation coefficients for the remaining variables.

In the third step, the variable with the largest partial correlation coefficient is computed, and the rest of the process is repeated. The program continues to operate until all variables have been entered. Using this program, one can determine the order in which the variables enter and the strength of the relationship. Thus one can evaluate the predictive ability of the variables.

Table 39 shows the results of the multiple regression runs for the individual products. In each instance, the first three or four variables explain the bulk of the variance. And in this case, those first three or four variables were the product perceptions. In the regression run with all products taken collectively, the five product perception variables are the first to enter the equation, and they explain the bulk of the variance.

## Table 39

## Multiple Regression

## All Variables

| Variables | Partial Correlation Coefficient | $R^2$ | % Increase in $R^2$ |
|---|---|---|---|
| Multiple Regression--Chicken Hot Dogs | | | |
| Relative Advantage | -- | 0.39333 | -- |
| Compatibility | 0.48573 | 0.53646 | 0.14313 |
| Income | -0.16162 | 0.54857 | 0.01211 |
| Age | 0.19776 | 0.56623 | 0.01765 |
| Trialability | -0.09726 | 0.57317 | 0.00695 |
| Complexity | 0.05797 | 0.57644 | 0.00326 |
| Communicability | 0.03429 | 0.57693 | 0.00050 |
| Education | 0.02140 | 0.57713 | 0.00019 |
| Multiple Regression--Chicken Au Gratin | | | |
| Relative Advantage | -- | 0.51890 | -- |
| Compatibility | 0.34389 | 0.57579 | 0.05690 |
| Trialability | -0.18857 | 0.59088 | 0.01508 |
| Communicability | -0.06883 | 0.59282 | 0.00194 |
| Age | 0.07005 | 0.59481 | 0.00200 |
| Income | -0.08463 | 0.59772 | 0.00290 |
| Complexity | 0.03236 | 0.59814 | 0.00042 |
| Education | 0.02620 | 0.59841 | 0.00028 |
| Multiple Regression--Bontrae | | | |
| Relative Advantage | -- | 0.50259 | -- |
| Compatibility | 0.24662 | 0.53284 | 0.03025 |
| Age | 0.21731 | 0.55490 | 0.02206 |
| Complexity | 0.11670 | 0.56096 | 0.00606 |
| Trialability | -0.09969 | 0.56533 | 0.00436 |
| Communicability | -0.08155 | 0.56822 | 0.00289 |
| Education | 0.07175 | 0.57044 | 0.00222 |
| Income | 0.02895 | 0.57080 | 0.00036 |

The author has already alluded to the question of Relative Advantage acting as a summary variable encompassing the other four perception dimensions. From the results displayed here, it appears that this, in fact, happens. Relative Advantage is the first variable to enter in each instance and explains the bulk of the variance. This is also true for the collective results shown on Table 40. Table 41 shows the results when Relative Advantage is left out of the equation. The first thing one notices there is that the $R^2$ drops sharply. The second thing one notices is that the demographic variables enter the equation earlier. Relative Advantage seems to be encompassing variable that contains more than one component, and in this study at least, it acts to suppress or mask the strength of the relationship with the other variables.

Even with Relative Advantage out of the equation, the product perception factors dominate. For all products, Divisibility and Compatibility account for the majority of the variance. This fact lends support to the contention that the perception of the product is important in the innovation process. Other insights provided by these results concern the question of "newness," to use Robertson's term once more. When Relative Advantage is withdrawn, the remaining perception variables drop in importance. The two mentioned earlier, Divisibility and Compatibility, are important for all three products, but Communicability seems to have no importance at all. Complexity is important only for the one product, Bontrae, that required substantial learning. It would seem then that people do differentiate along the "newness" dimension and that their perception is affected by that dimension.

For the types of food products dealt with in this study, Divisibility and Compatibility are important along the entire dimension--Complexity only for the discontinuous product. Rather than helping to predict

## Table 40

## Multiple Regression

## Without Relative Advantage

| Variable | Partial Correlation Coefficient | $R^2$ | % Increase in $R^2$ |
|---|---|---|---|
| Multiple Regression--Without Relative Advantage | | | |
| Chicken Hot Dogs | | | |
| Compatibility | -- | .27631 | -- |
| Trialability | -.39061 | .38673 | .11041 |
| Income | -.25530 | .47038 | .08365 |
| Age | .17475 | .48656 | .01617 |
| Complexity | .09122 | .49082 | .00426 |
| Communicability | .07058 | .49335 | .00254 |
| Education | -.06784 | .49569 | .00233 |
| Chicken Au Gratin | | | |
| Trialability | -- | .25611 | -- |
| Compatibility | .38924 | .36882 | .11271 |
| Income | -.17836 | .40263 | .03381 |
| Education | -.07692 | .40616 | .00353 |
| Age | .05011 | .40765 | .00149 |
| Complexity | -.01236 | .40774 | .00009 |
| Communicability | | Did not compute | |
| Bontrae | | | |
| Trialability | -- | .38246 | -- |
| Compatibility | .29358 | .43568 | .05322 |
| Complexity | .17114 | .45221 | .01653 |
| Age | .18326 | .47061 | .01840 |
| Education | .09481 | .47537 | .00476 |
| Communicability | -.06113 | .47732 | .00196 |
| Income | .05209 | .47875 | .00142 |

## Table 41

## Multiple Regression - All Products With and Without Relative Advantage

| Variables | Partial Correlation Coefficient | $R^2$ | % Increase in $R^2$ |
|---|---|---|---|
| **Multiple Regression - All** | | | |
| Relative Advantage | | 0.55724 | |
| Compatibility | 0.27926 | 0.59177 | 0.03453 |
| Complexity | 0.20316 | 0.63023 | 0.03846 |
| Communicability | 0.08982 | 0.63321 | 0.00298 |
| Trialability | 0.10203 | 0.63703 | 0.00382 |
| Income | 0.09148 | 0.64007 | 0.00304 |
| Age | 0.09514 | 0.64333 | 0.00326 |
| Education | 0.03572 | 0.64378 | 0.00046 |
| **Multiple Regression - Omitting Relative Advantage** | | | |
| Trialability | | 0.27413 | |
| Compatibility | 0.35454 | 0.36538 | 0.09124 |
| Income | 0.10848 | 0.42137 | 0.05599 |
| Age | 0.17094 | 0.43828 | 0.01691 |
| Complexity | 0.14488 | 0.45007 | 0.01179 |
| Education | 0.03682 | 0.45081 | 0.00075 |
| Communicability | 0.01675 | 0.45097 | 0.00015 |

innovative behavior, Relative Advantage seems to be made up of a number of components, and therefore it is not a precisely defined dimension by itself. In future research, it would probably be wise to drop this variable and attempt to determine and use more specific components.

## The Role of Perception in the Development of Adoption Strategies for New Food Products in the Food Service Industry

Thus far, the results of this study have suggested the extent to which a consumer's perception of a new food product along the dimensions postulated by Rogers can help explain innovative behavior. It remains only to show how these findings can be translated into strategies that can be used by a food service operation to help increase the sales of new products. Toward this end, the author can make these three suggestions: First, the process an individual goes through in the adoption of a new product can be depicted on an "adoption model." Second, it can be shown where the perceptual characteristics that we have been discussing interact with this model to hinder or facilitate the adoption of the product. And third, utilizing this model, one can present possible strategies, applicable to the food service industry, for enhancing the positive aspects of the perceptual characteristics to facilitate adoption.

### The Adoption Process

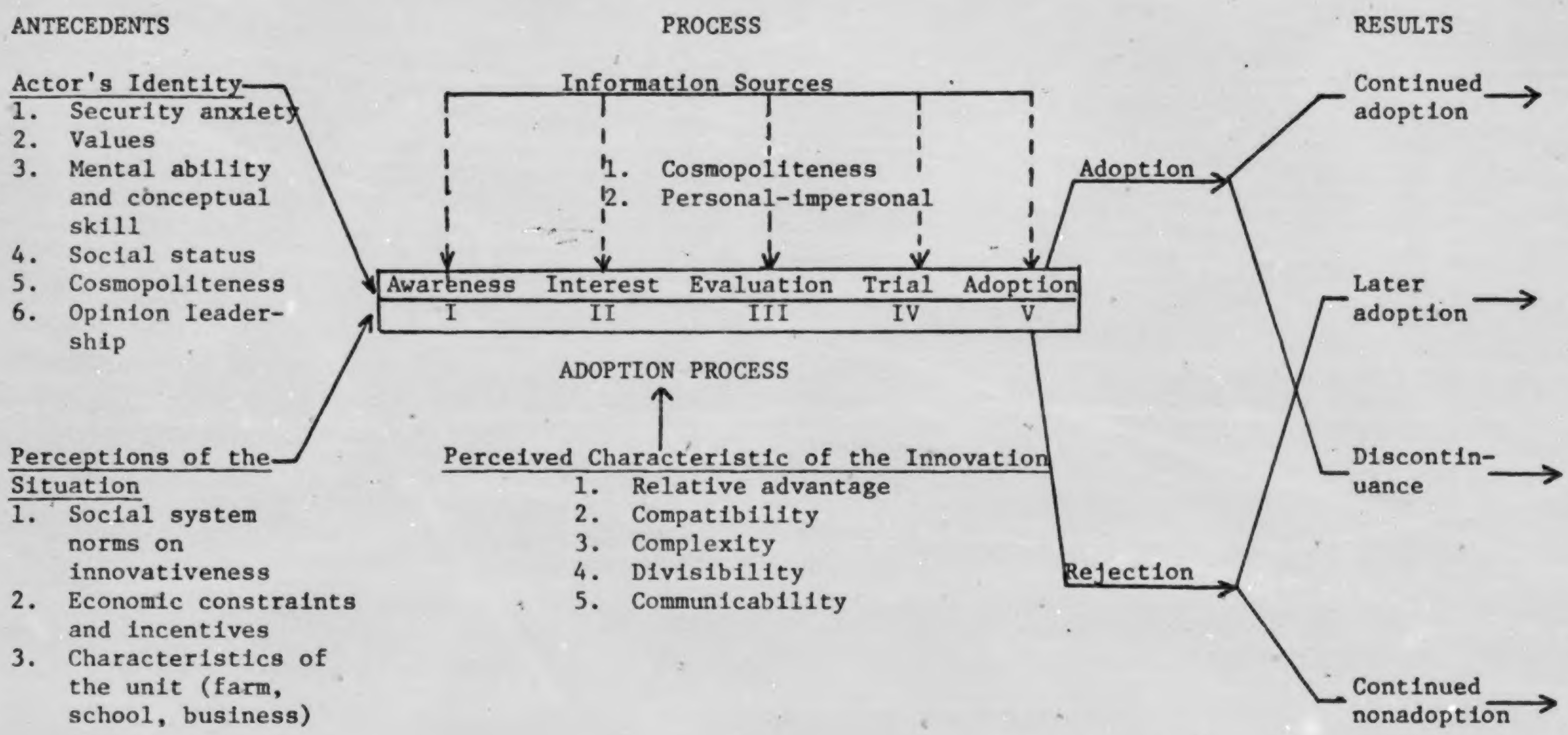
Before one can predict purchasing behavior, he must have an understanding of the process an individual undergoes in arriving at his decision to purchase. This is called the "adoption process." and it has been defined by Ostlund as "the multistage mental and behavioral process assumed to take place in an individual, leading from awareness of the innovation to ultimate adoption, or commitment to that innovation."

The adoption process has been depicted as a model containing five stages or steps an individual must pass through. Figure 1 shows how Rogers postulates the adoption process and how the model fits into the overall scheme of adoption. At present, the adoption process model is general. And it lacks consistent ties with current theoretical representations of the cognitive decision processes. But this shortcoming if bound to be rectified by further research.

The first stage of the model is awareness, which refers to an individual becoming consciously exposed to the product. (That individual may have been exposed to the product previously without being consciously aware of it. In fact, this situation is rather common: it may take repeated exposures before a person becomes aware of a product.) Awareness may come about either from accidental exposure or from a diffusion process involving some form of advertising or word-of-mouth communication.

In the interest stage, the individual begins to perceive some attraction or usefulness in the new product and becomes receptive to new information about that product. Or he may be stimulated to seek additional information from either formal or informal sources. If the initial attraction remains or is enhanced, the individual moves to the third stage, or evaluation. Here he compares the information he has gathered about the new product with his needs and his old ways of doing things. In performing this evaluation, his values, income, past experiences, and a host of other characteristics play a role--along with certain perceived characteristics of the product. If that evaluation is negative, the adoption process ceases and the individual loses interest

Figure 1. Process of Adoption of an Innovation by an Individual


ANTECEDENTS
PROCESS
RESULTS
Actor's Identity
1. Security anxiety
2. Values
3. Mental ability and conceptual skill
4. Social status
5. Cosmopoliteness
6. Opinion leadership
Perceptions of the Situation
1. Social system norms on innovativeness
2. Economic constraints and incentives
3. Characteristics of the unit (farm, school, business)
Information Sources
1. Cosmopoliteness
2. Personal-impersonal
Awareness
I
Interest
II
Evaluation
III
Trial
IV
Adoption
V
ADOPTION PROCESS
Perceived Characteristic of the Innovation
1. Relative advantage
2. Compatibility
3. Complexity
4. Divisibility
5. Communicability
Adoption
Rejection
Continued adoption
Later adoption
Discontinuance
Continued nonadoption

Source: Everett M. Rogers, Diffusion of Innovations (New York: MacMillan, 1962), p. 306.

in the product. But if it is positive, the individual awaits an appropriate occasion for moving into the trial stage.

At the trial stage, the act of trying the product does not, by itself, guarantee adoption. It may be necessary for the individual to go through an ongoing process of evaluation by repurchasing the product one or more times before he makes his commitment to it. Depending upon the importance of that decision, there can be a certain amount of cognitive dissonance generated at the trial stage.

In the final stage of the process, adoption, the individual makes a commitment and becomes a regular purchaser of the product. Cognitive dissonance is, typically, the problem to be overcome at this stage. For an individual to become committed to a new product, he must, to some extent and in some manner, alleviate the discord that arises in his mind about the worth of the action he has taken. If he can eliminate that discord, he will remain a regular user. But if the discord persists, the individual will revoke his commitment.

## Perceptual Characteristics and Product Adoption

The way in which an individual perceives a new product along the five dimensions already discussed can do a great deal either to hinder or facilitate his progress through the steps of the adoption model. As Rogers postulated it, the adoption model is quite general, and its usefulness is therefore limited. But one can be more specific and suggest how and where each of the perceptual dimensions has its greatest impact in the model.

Relative Advantage refers to the degree to which an innovation is seen as superior to the idea it is meant to supersede. It is perhaps the most important of the perceptual dimensions, for if an individual does not perceive (or "see") the relative advantages of a new product, it has virtually no chance of adoption--even if all the other dimensions score high. As previously pointed out, it may well be that Relative Advantage acts as a summary dimension, encompassing all of the others. In fact, the multiple regression results, where Relative Advantage consistently became the first variable to enter the equation, suggest this interpretation.

Relative Advantage, in any case, would be the most important of the variables since it has its greatest impact early in the adoption process and may stop the whole process at the outset. More specifically, Relative Advantage has its greatest impact in the interest stage of the adoption model. If the individual perceives some attraction or usefulness in the product--that is to say, if he sees some "relative advantage" in it--he becomes receptive to further information about it.

Thus, in many new product introductions, the promoter's initial attempt is to make the individual consciously aware of the product and then to present its Relative Advantage in as simple and direct a way as possible. This way, he "hooks" the individual's interest and makes him more receptive to further information. This is tantamount to moving the individual into the evaluation stage where other dimensions begin to make their impact (while Relative Advantage retains its impact).

In the evaluation stage, an individual gathers even more information and eventually compares his accumulated information about the new product with his needs and his old ways of doing things. (This is what Rogers called the "Actor's Identity," as shown in Figure 1 as an antecedent of the model.) The perceptual dimensions of interest here are Compatibility and Complexity.

The impact of the Complexity dimension is easy enough to understand. If an individual cannot understand how a product is used, he is liable to evaluate it negatively, and he will abort the adoption process. For Compatibility, however, there are at least two well-defined important components. The first is Compatibility with respect to norms and values. New products that fail to fit existing norms and values tend to be evaluated negatively. (In the past, some of the new soy-meat products and some "TV dinners" fell victim to this tendency: They were evaluated negatively by major segments of the market because they offended the norms and values of those homemakers who saw them as "cheap" or saw themsleves as lazy and uncaring when they served them.) The second component of Compatibility involves an individual's habits or "ways of doing things." Those products that fit the individual's life-style or time schedule have a good chance of earning a high Compatibility score and thus progressing through the adoption process.

If his perception of Compatibility is positive, the individual generally waits for an opportunity to move into the trial stage. Two considerations are important here. The first is the occasion for that trial. A positive evaluation of a new product is no guarantee that the trial will occur. The individual must encounter an appropriate occasion for using the product. Thus, products with a broad appeal and wide usefulness will be tried quicker than those with only limited appeal or usefulness. (As the reader can see, this consideration reflects the perception of Relative Advantage, and it may actually be just another facet of that dimension.) The second important Compatibility consideration is the individual's perception of the ease with which he can try the product. The trial is not, after all, necessarily a commitment to adopt.

An individual wants to be able to try the product without risk or commitment. If he cannot, two options remain open to him. He can go back to the evaluation stage, acquire more information through his formal or informal sources, and then reevaluate the product in an attempt to reduce his risk. Or, more commonly, he may abort the adoption process. The dimension of Complexity also exerts an impact at this stage. If the individual has difficulty using the product because of its complications, the process will stop and the individual will fail to adopt the product.

It is in the area of cognitive dissonance, discussed at the conclusion of the previous section, that the Communicability dimension exerts its greatest impact. One of the strategies used by consumers to reduce cognitive dissonance is to discuss a new product, the individual rationalizes his action. If, however, he is unable to communicate his feelings about the product, either because of social pressure or because of an inability to articulate various aspects of the purchase or use, the chances of lessening the cognitive dissonance are reduced and along with them, the probabilities of adopting the product.

## Food Service Strategies for New Product Adoption

For a product to be successful, it is evident that consumers must be encouraged to move completely through Rogers' new product adoption model. Their perceptions of the product, acting in concert with Rogers' five dimensions, can either hinder or help that movement. Understanding this movement, the food service professional's job becomes one of instituting strategies to enhance perception in those instances where this research suggests a product could be perceived hazily along one or more of the dimensions.

A product low in Relative Advantage is perceived as not having some outstanding feature to differentiate it from that product it is meant to replace. In the research reported here, for example, the Relative Advantage of chicken hot dogs was not perceived as especially high. On a scale of 1 to 6, with 1 representing high Relative Advantage, the mean score for the chicken hot dog was 4.6. The respondents obviously didn't see much advantage here over the regular hot dog. What one might try to do would be to emphasize some feature in the product that helps differentiate it from other hot dogs and imbue it with an aura of superiority. If one were to put the product on a menu, he might emphasize its price and sell it for less than a regular hot dog. Or he might stress that, unlike most hot dogs, the chicken hot dog is 100-percent meat with no oatmeal or other fillers--both an esthetic and an economic advantage. Or he might advertise the healthful aspects of the product: It has fewer calories and is lower in cholesterol than the typical hot dog. (If the menu contained a "dieter's corner" or a health food section, it might feature the chicken hot dog.)

To ensure that an individual perceives the Compatibility dimension sharply, the food service professional has a number of options open to him. Certain kinds of advertising can emphasize the product's Compatibility with norms and values. Showing the new product in situations with which a consumer is comfortable and with which he can readily identify might suffice. A television or magazine campaign showing happy families ordering and enjoying the product might also succeed. (In fact, this technique is already in use among some of the major fast food chains.) Another technique uses a well-known personality who embodies appropoiate characteristics to endorse the product. (Thus we see the invariably neat cowboy, Roy Rogers, actively promoting a fast food chain specializing in "western-style" foods.) A variant of this technique creates a fictional personality and imbues it with certain desirable characteristics. ("Uncle Ben," "Betty Crocker," and "Aunt Jemima," the southern-style rice maker, the expert baker, and the pancake and waffle queen, respectively, are three familiar examples.)

To achieve Compatibility with consumer habits, one should make the product available in familiar forms. For example, anyone working with a chicken-flavored soy-dice product ought to use it in the preparation of dishes his consumers already know and like. He might, for example, feature tomatoes stuffed with chicken salad, or creamed chicken in a pastry shell.

The Complexity problem is typically handled by employing various forms of information dissemination. If an individual does not understand what a product is or how it is used, he must find sufficient information to clear up his confusion. Obviously the information should be provided in a convenient manner--and the quicker the better, so that the consumer doesn't lose interest. Moreover, a consumer will not normally invest a great deal of time and effort in information gathering designed to lessen the complexity of a product. He is more apt to abort the adoption process. In a restaurant setting, then, one could include a detailed description of the product on the menu or set up "table tents." (This strategy has, in the past, successfully "moved" both less-popular foods and "experimental" dishes.) Still another strategy might be to train waiters and waitresses to provide the information.

The problems of Divisibility can be solved in a number of ways. The most common approach in the restaurant industry is to offer the product at a reduced price, or as some sort of "special" (two-for-the-price-of-one, for example), or as part of an offer (Try our ocean krill and take home a cut glass tumbler"). Another approach is to provide free samples of the new product during the meal or at a demonstration table. This approach can, in fact, be used in conjunction with the Compatibility and Complexity approaches by emphasizing the positive characteristics of the product and answering the guests' questions as they sample the product.

## Conclusion

The strategies suggested by this study are relatively uncomplicated. But before more sophisticated strategies can be developed, more research must be performed in the area of product perception. The general formulations by Rogers, Ostlund's attempts at empirical proof, and the study at hand all provide insight. But they raise even more questions. First, have the perceptual dimensions been operationalized correctly? The author spoke of the problems inherent in calling Relative Advantage a "summary variable" encompassing a number of components. The multiple regression results seem to bear out this analysis, but a marketeer must be certain.

Second, do other perceptual dimensions remain untested that are nevertheless important to a consumer deciding upon a new food purchase? From the multiple regression results in this study, one can see that, at most, only 65 percent of the variance can be confidently explained. Are there other dimensions that might help to explain more of the variance? Other researchers have found that a brand name, for instance, may be an important consideration in an individual's willingness to become a food product innovator. People sometimes seem to trust the products of certain manufacturers and seem, therefore, more willing to try new products developed by these companies. (In fact, new product advertising often emphasizes the company as much as the product itself.) By the same token, customers might be more willing to try the "Canapes of Krill" in a restaurant they know and trust, as opposed to an unfamiliar restaurant in a strange town.

Third, have all dimensions been weighted equally or are some more important to the consumer than others? (And does the consumer "see" all of the dimensions?) The discussion of Complexity seemed expecially appropriate in the case of the Bontrae soy product, but it plainly exerted little effect in the case of the other two products. It may be that this dimension overshadowed the others in the minds of the consumers who inspected the Bontrae, effectively blocking a positive response.

Finally, to what extent does the "newness" of a product enhance or contribute to a clearer perception of that product? It is impossible, really, to talk about strategies for introducing "new" food products without at least a working definition of "newness." (Would it include a new form of a familiar product, like chicken hot dogs, frozen french-fried potatoes, or molded onion rings? Or would it be restricted to a more unfamiliar food mixture, like "space food sticks"?)

Certainly more questions than these remain to be answered, but these are the major ones. As the answers are found and the role of product perception becomes clearer, strategies for introducing new food products will become increasingly sophisticated. As that happens, we can certainly expect to see the restaurant industry assume an increasingly important role in the use of "new" foods like the three that formed the basis of this study and, indeed, like the futuristic trio described on the first page of this report.

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# THE PENNSYLVANIA STATE UNIVERSITY'S
# CONSUMER TASTE PANEL EXPERIMENT

by

Leo M. Renaghan, M.B.A.

and

Peter J. Bambic, M.B.A.

# THE PENNSYLVANIA STATE UNIVERSITY'S
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## Introduction

Implicit throughout this report is the idea that freezing is an ascendant food preservation method in our society. The volume of frozen foods has increased substantially in each recent year, and it would appear that this increase will continue in the foreseeable future. Moreover, the demand for foods of all sorts, most particularly foods associated with the "fine-dining sector," will continue to increase. Thus the freezing of "gourmet foods" emerges as one of the survival strategies almost certain to be adopted by the commercial restaurant industry. (The technology and, to some limited extent, the actual gourmet products are already available.)

This observation supports the idea, also implicit in this report, that the continuing increase in the use of frozen foods and the technological capability for a radical increase in the amount, variety, and quality of this food over the next ten years will require vocational-technical programs to direct more attention to the concrete applications of food science in order to prepare their students to become more kitchen technologists than old-fashioned culinary artisans.

As reported elsewhere in this volume, Dr. Manfred Kroger and his associates conducted an organoleptic taste panel experiment on the Pennsylvania State University campus designed to determine whether the freezing of certain gourmet foods brought about differences in that food sufficient to be detected by a trained food-tasting panel. To balance Dr. Kroger's experimentation, the authors set out to determine whether ordinary consumers, accustomed to fine dining and oriented toward it but in no way organoleptically trained, could detect differences between certain freshly prepared and frozen gourmet foods.

Though the design and goals of this experimentation were more modest than those of Dr. Kroger, the implications for the food service industry are, if anything, much more significant--particularly in view of the fact that subjects like the ones in this experimentation are far more representative of the food-buying public than the members of an organoleptic panel.

## Method

### Summary of the Design

On February 11 and again on April 14, 1975, the authors conducted experiments in the Maple Room, a fine-dining environment contiguous with the food preparation laboratory of the Food Service and Housing Administration Program (FSHA) of the Pennsylvania State University's College of Human Development. These experiments were duplicated on February 18 and April 21. Both sets of experiments were designed to measure the effect, or the lack of effect, freezing and reconstitution has on the quality of certain gourmet foods as that quality is appraised by a group of ordinary consumer subjects. Both sets of experiments were conducted along multiple dimensions.

The gourmet food items were prepared by various members of the FSHA undergraduate student body who were enrolled in FSHA 410, an advanced food preparation and food customs course. On February 11, and again on February 18, the students prepared large batches of three and five gourmet items, respectively. In each case, half of that food was served in the usual manner--that is, fresh, "from scratch." The other half was frozen so that it might be reconstituted at a later time and served as though it were fresh.

On all four occasions, at the completion of the dinner, the subjects were asked to fill out a short questionnaire that assessed their reactions to the quality of the food items they had just eaten. As a manipulation control against any unexpected effects, the dessert was prepared and served fresh.

The experiments may be summarized as a subjects' nested in three (or five) different product (gourmet food) conditions and crossed with two processing (fresh and frozen) conditions. That is, each subject evaluated all of the experimental foods within one, but only one, of the two processing conditions. Table I summarizes the study design for the first experiment (February 11 and April 14). An equivalent design was used for the second experiment, with the exception that five food items instead of three were evaluated.

## Subjects

A total of 41 subjects participated in Experiment I and 39 participated in Experiment II. They were, broadly speaking, representative of the Pennsylvania State University community, and most of them had attained schooling beyond the level of the bachelor's degree. None of the subjects had acquired any special organoleptic training. They fell into two groups, determined by the preparation method of the food they ate. The group that tasted the food in the fresh, from scratch condition consisted of 19 usable respondents,

Table I. Summary of the Experimental Subjects in Products Crossed with Preparations Design for Experiment I

| | | PRODUCTS | | |
|---|---|---|---|---|
| | | onion soup | chicken Normandy | Bouchee a la Reine |
| PREPARATIONS | fresh | $X_{1\ 1\ 1}$<br>⋮<br>$X_{1\ 19\ 1}$ | $X_{1\ 1\ 2}$<br>⋮<br>$X_{1\ 19\ 2}$ | $X_{1\ 1\ 3}$<br>⋮<br>$X_{1\ 19\ 3}$ |
| | frozen-reconstituted | $X_{2\ 1\ 1}$<br>⋮<br>$X_{2\ 22\ 1}$ | $X_{2\ 1\ 2}$<br>⋮<br>$X_{2\ 22\ 2}$ | $X_{2\ 1\ 3}$<br>⋮<br>$X_{2\ 22\ 3}$ |

while the group that tasted the food in the frozen-reconstituted condition consisted of 22 respondents for Experiment I. In Experiment II, the numbers were 23 and 16, respectively. No participant was aware that he was part of an experimental situation.

## Summary of the Procedure

Upon entering the Maple Room, the subjects were seated at a dining table just as though they had entered a fine restaurant. The setting was complete with appropriate decor, a bill of fare, waiters, and a maitre d'hotel. Students fulfilled all the service roles, but the same students did not necessarily fill the same roles during all four of the testing situations. The maitre d' greeted the assembled participants and invited them to enjoy a fine-dining experience. The waiters then served a multiple-course dinner in a manner characteristic of a gourmet restaurant.

After completing their meals, the subjects were asked by the maitre d' to take a few moments to complete a questionnaire. The questionnaire had actually been designed to evaluate the experimental food although the maitre d' suggested that it would be used to help the FSHA 410 students in their planning and preparation of future meals. (The questionnaire did, indeed, serve this additional purpose.)

No subject was told anything whatsoever about the preparation methods of any of the food served. But if they made any assumptions, presumably it was that the food had been prepared "from scratch," the usual custom of the 410 dinners. In fact, the subjects apparently regarded the four occasions as merely typical Maple Room 410 dinners.

After completing the questionnaire, the subjects were free to leave. They were not subsequently informed of the nature of the experiment in which they had participated. And in all cases, upon leaving, they paid the pre-determined sum of money commensurate with the usual charge for a Maple Room 410 dinner.

The Independent Variable

Products. All subjects in Experiment I dined on a multiple-course French provincial meal; those in Experiment II dined on a multiple-course Continental meal. The experimental, or manipulated variables were comprised of three and five of the courses, respectively. In Experiment I, an additional course, the dessert, served as a control. The experimental foods in Experiment I were chicken Normandy, onion soup, and Bouchee a la Reine. In Experiment II they were cream of carrot soup, chicken liver toasts, shrimp Portuguese, noisettes of beef with fresh mushroom sauce, and cauliflower in mornay sauce. (Complete recipes for both of these dinners appear in Appendix A to this paper.)

Preparation. The preparation procedure dictated that one batch of the three and five experimental products be served fresh, "from scratch," while the second batch be frozen, held for 62 days, reconstituted, and served as though fresh. In the first dinner, the onion soup, the chicken Normandy, and the Bouchee a la Reine were all frozen. In Experiment II, the chicken liver and the two sauces were frozen, but the noisettes of beef and the cauliflower were served fresh both times. The soup and shrimp Portuguese were frozen. The gourmet food items were prepared by the FSHA 410 students and the items destined to be frozen were packaged hot in commercially available, 12-ounce freezing-boiling bags as soon as the cooking process had ended. The bags were doubly heat-sealed, and the students took care to exclude as much air from the product as they could. Moreover, the food was distributed evenly throughout the bag to allow for speedy cooling and freezing.

The filled freezer bags were placed, one layer thick, in rows on trays. The trays were transported (in every case, within 75 minutes of the beginning of the bagging process) to a blast freezer with a temperature of -20° F. It took from 20 minutes to an hour for all of the bags to freeze, at which time they were assembled in a large cardboard box inside the freezer. All of the frozen gourmet food destined for Experiment I and Experiment II remained in the blast freezer, undisturbed, for 62 days.

At the end of the storage period and just before the subjects came to dinner, the pouches were reconstituted in boiling water. Then they were cut open and the contents of each item were mixed and portioned (ungarnished, and free of any additional ingredients) for the 410 diners. The freshly prepared control food items were similarly portioned for the diners.

## The Dependent Variables

The questionnaire distributed at the completion of the meals contained a series of five-point scales in which a subject could evaluate the individual items and make an overall evaluation of the dinner. Each food item in Experiment I was rated on the scales along the following dimensions:

1. Temperature: "Hot" to "Cold"
2. Aroma: "Pronounced" to "Imperceptible"

3. Overall flavor: "Very desirable" to "Flat"
4. General acceptability: "Excellent" to "Very poor"

(In Experiment II, the five items were rated on aroma, overall flavor, and general acceptability only. Copies of the actual questionnaires appear as Appendix B to this report.) In addition, the subjects rated the overall quality of all the dinners on a five-point scale with end-points labeled "Excellent" to "Very poor."

## Results

### Manipulation Control

The evaluations obtained from the dessert item, chocolate cake, freshly prepared for each session of Experiment I determined whether the presence of an extraneous variable, in addition to the treatment or experimental variables (the preparation condition) might have affected the results. (It was, of course, not feasible to randomly assign subjects to treatments.) For example, the occasions on which the dinners were held, the temperature of the dining room, and perhaps other unforeseen factors could have been operating in the two 62-day delays between sessions of the two experiments. Such factors as these would have been revealed in the differential ratings of the fresh dessert in Experiment I. If such differences occurred, we would have less confidence in the conclusions concerning the effect of the preparation variable. A one-way multivariate analysis of variance (MANOVA) was performed on the following variables for the dessert item, measured on five-point scales with end-points labeled as indicated:

1. Moistness: "Very moist" to "Very dry"
2. Appearance: "Very pleasing" to "Very unpleasant"

3. Texture: "Very fine" to "Very coarse"
4. Overall flavor: "Very desirable" to "Flat"
5. General acceptability: "Excellent" to "Very poor"

The multivariate analysis revealed that no significant differences existed between the evaluation of the dessert along the five dimensions among the subjects in the two experimental sessions. The Chi-square ($X^2$) approximation on 5 degrees of freedom is 4.217; $X^2$ (5) at $\alpha = 0.05$ is 11.07. Thus uncontrollable variables, which might have resulted in differences between the subjects' ratings, appear not to have been present. This result provided us with increased confidence in our hypothesis of the effects due to the preparation process. Due to the overwhelming evidence in support of the lack of differences in the cake ratings between sessions of Experiment I, an additional manipulation control for Experiment II did not appear to be necessary.

## Tests of the Hypothesis

The principal hypothesis tested independently by these two experiments can be stated this way: Do subjects' evaluations across the products (the repeated measure factor) on the four dependent variables differ according to the type of preparation (i.e., from scratch versus frozen-reconstituted)? In the MANOVA design, this hypothesis was tested by the products by preparation interaction. For Experiment I, this test yielded an approximate Chi-square statistic based on 8 degrees of freedom of 1.563. (Chi-square x 8 at $\alpha = 0.05$.) In Experiment II, a Chi-square approximation on 12 degrees of freedom yielded a value of 10.314. At the $\alpha = 0.05$ level, $X^2$ (12) = 21.03, indicating no significant difference in the rating of the multiple dependent variable, as in Experiment I.

Thus, one can conclude that the within-subjects ratings on all dependent variables across the products and between the two types of preparation do not differ in each experiment. That is to say, as expected, there was no difference in item evaluation due to its preparation process.

Consistent with these results are the subjects' ratings of the overall quality of the four dinners. An ANOVA test of this variable yielded an F-ratio on 1 and 39 degrees of freedom equal to 1.163, compared to F (1, 39; 0.05) = 4.09. Thus, the hypothesis of no difference in overall quality ratings between dinners for Experiment I was not rejected. In Experiment II, an F-ratio for the same variable on 1 and 37 degrees of freedom was found to be 2.891, compared with F (1, 37; 0.05) = 4.11. Thus an identical hypothesis was not rejected.

These results offer further evidence in support of the finding that processing had no effect on the subjects' evaluation of the dinner. In addition, an inspection of the ratings reveals not only that there was no effect attributable to the processing within the experimental products, but also that all of the ratings were generally very favorable. Of the possible 12 ratings in Experiment I (4 dimensions x 3 products) on which each subject responded, the following abbreviated frequency distributions on 228 and 264 aggregated responses were noted: over 80 percent of the responses to the food served fresh were either "one" or "two"; and over 75 percent of the responses to the food that had been frozen and reconstituted were either "one" or "two." For the 15 ratings per subject in Experiment II, the results on 315 and 240 aggregated ratings were 58 and 68.5 percent, respectively, rating the quality as "favorable."

## Concluding Remarks

Some final notes concerning the effect of freezing on gourmet foods are in order here. First, these results statistically apply only to the study in which the effect of freezing on the certain specified items was observed. Owing to the slight differences in the "favorable" ratings discussed in the preceding section, it appears that the nature of the food items, per se, or perhaps all of them (frozen and fresh) that were initially prepared, has an effect on the item's ability to tolerate freezing. This does not mean that freezing will have no effect on the quality ratings for all other, or some other gourmet foods.

Secondly, the span of 62 days between the fresh and the frozen-reconstituted situations also limits the general applications of the results. We do not know for certain what the results would be if the time span were extended or shortened. If some future food science researcher suspects that the quality of "gourmet food" varies with the amount of time the food is held in its frozen state, and with the type of food involved, he could easily replicate this experimental pattern varying the time span. Such experimentation would probably extend the general applicability of this research.

# Appendix A

## Recipes for Gourmet Foods Tested in the Consumer Panel Experiment

## Chicken Liver Toasts
### (Small Quantity)

Size of Serving: 2 Rounds Spread with 1 Tbsp. filling each

Yield: 30 Servings

Ingredients:

| | |
|---|---|
| 12 Ounces | Chicken Livers |
| 1 Pound | Beef Liver |
| 8 Ounces | Minced Onions |
| 1/2 Cup | Olive Oil |
| 1/2 Cup | White Wine (55444) |
| 2 Cloves | Garlic, crushed |
| 1/4 Cup | Chicken Broth |
| 2 Tablespoons | Capers |
| 2 | Anchovies, washed under running water and then crushed |
| 2 Loaves | Thinly sliced French Bread |
| 4 | Hard-cooked, chopped Eggs |

Preparation:

1. Clean livers. Cut beef livers into pieces about 2" square.
2. Brown livers and minced onions in olive oil in hot skillet - about 5 minutes.
3. Pour in wine. Let evaporate over moderate heat.
4. Add crushed garlic. Cook for 3 minutes more.
5. Chop in food chopper.
6. Return to skillet. Add 2 tablespoons chicken broth, capers, and crushed anchovies. Season to taste with salt and pepper.
7. Slice bread thinly. Toast in oven until brown and crisp. Moisten toast with chicken broth using pastry brush. Spread with 1 tablespoon hot liver paste. Garnish with chopped egg. Serve hot.

## Cream of Carrot Soup
(Small Quantity)

Size of Serving: 3/4 cup (6 oz.)

Yield: 10 Servings

Ingredients:

| | |
|---|---|
| 3 Tablespoons | Butter |
| 2 Pounds | Carrots, Thinly Sliced |
| 5 Ounces | Onions, Thinly Sliced |
| Pinch | Thyme |
| 2 Quarts | White Veal or Chicken Stock |
| 1/3 Cup | Raw Rice |
| 3 Tablespoons | Butter |
| | Salt and Pepper |

Preparation:

1. In a large pan melt first amount of butter. Add carrots, onions and thyme. Cover tightly and steam for 10 minutes.
2. Add stock and bring to a simmer.
3. Sprinkle in raw rice and simmer for 35 minutes.
4. Puree in food mill or in blender. Return to pan and bring to simmer.
5. Correct seasoning. Thin, if desired with hot stock.

Service:

1. Add 3 tablespoons butter. Stir well.
2. Serve in heated soup bowls.

## Shrimp Portuguese
## (Small Quantity)

Size of Serving: 4 oz. over patty shell

Yield: 6 Servings

### Ingredients:

| | |
|---|---|
| 1 Pound | Shrimp, frozen without shell (smallest size) |
| 3 Ounces | Butter |
| 1/3 Cup | Chopped Green Onion |
| 1 Cup | White Wine (Sauterne) |
| 2 Tablespoons | Tomato Paste |
| 3/4 Teaspoon | Sugar |
| 1 1/2 Teaspoon | Salt |
| 1/2 Teaspoon | MSG |
| 2 Drops | Tabasco Sauce |
| 3 Tablespoons | Purity 69 |
| 1/2 Cup | Sauterne |

### Preparation:

1. Cook shrimp for 3 minutes in simmering seasoned water. (pinch salt, bay leaf, slice of lemon). Drain shrimp.
2. Melt butter. Add chopped onion and cook until onion is transparent. Remove from heat.
3. Mix together first amount of wine, tomato paste, sugar, salt, MSG, and Tabasco Sauce. Add to onions. Add shrimp. Return to heat and bring to simmer.
4. Mix purity 69 and remaining white wine. Add to shrimp mixture, stirring constantly. Cook until thickened. If fat should start to separate out, add cold water and stir rapidly.

### Service:

1. Serve 4 oz. portion over patty shell (bouchee).

## Fresh Mushroom Sauce
## (Small Quantity)

Size of Serving: 1 1/2 Oz.

Yield: about 1 Quart

### Ingredients:

| | |
|---|---|
| 1 Pound | Fresh Mushrooms |
| 3/4 Cup | Melted Butter |
| 1/2 Cup | Chopped Carrots |
| 4 Ounces | Chopped Onions |
| 1 | Bay Leaf |
| 1/2 Teaspoon | Peppercorns |
| 1 1/4 Quarts | Meat Stock |
| 3 Ounces | Flour |
| 3 Ounces | Purity 69 |
| | Salt and Pepper to Taste |

### Preparation:

1. Add carrots, onions, bay leaf and peppercorns to meat stock. Cook 20 to 25 minutes, covered. Strain. If you do not have 1 quart of strained liquid, add sufficient water to make this amount.
2. Slice mushrooms and add to melted fat. Saute in fat until browned. Remove from fat.
3. Add flour to fat. When well blended, add meat stock. Cook until thickened (about 20 minutes). Correct seasoning. Add sauteed mushrooms and serve. Serve over beef noisettes.

## Cauliflower in Mornay Sauce
(Small Quantity)

Size of Serving: 3 oz. cauliflower, 2 oz. sauce

Yield: 10 Servings

Ingredients:

| | |
|---|---|
| 1 Ounce | Butter |
| 2 Tablespoons | Flour |
| 2 Tablespoons | Purity 69 |
| 1/4 Cup | Non-fat dry milk |
| 3/4 Cup | Water |
| 1 Cup | Heavy Cream |
| 2 2/3 Cups | Grated Cheddar Cheese |
| | Salt and Pepper to taste |
| 2 to 2 1/2 Pounds | Frozen Cauliflower |
| 1/4 Cup | Fine Bread Crumbs, Buttered and Toasted |

Preparation:

1. In a sauce pan blend butter, flour and Purity 69. Cook slowly, stirring constantly with wire whip, until butter is melted.
2. Mix dry milk and cold water.
3. Remove from heat and gradually add milk and cream, stirring constantly.
4. Return to fire. Bring to a boil, stirring constantly. Boil one minute.
5. Blend in cheese and remove from heat.
6. Cook cauliflower according to directions on package. Be sure not to overcook. Do not hold after cooking.
7. Serve 2 oz. Mornay sauce over 3 oz. cauliflower. Sprinkle with toasted, buttered bread crumbs.

## Appendix B

## The Questionnaire

How many children do you have?

Number: _____ Ages: ______________________________

What is your husband's approximate age?

1. Under 26 _____
2. 26 to 30 _____
3. 31 to 35 _____
4. 36 to 40 _____
5. 41 to 45 _____
6. 46 to 50 _____
7. 51 to 55 _____
8. 56 to 60 _____
9. 61 to 65 _____

What is your husband's exact position? (PLEASE be very specific--for example, not clerk, but retail clerk; not salesman, but insurance salesman)

______________________________________________

Are you employed outside the home?

1. Yes _____ 2. No _____

If yes, (1) part time? _____ (2) full time? _____

Exact position: ______________________________

Would you please indicate your total 1974 family income earned by your husband and you? (Check one, please. This information is only for classification purposes and is held strictly confidential.)

1. Under $5,000 per year _____
2. $5,000 to $7,999 _____
3. $8,000 to $9,999 _____
4. $10,000 to $11,999 _____
5. $12,000 to $14,999 _____
6. $15,000 to $19,999 _____
7. $20,000 to $24,999 _____
8. $25,000 to $29,999 _____
9. $30,000 to $34,999 _____
10. Over $35,000 _____

How many years of formal education has your husband completed? (Check one)

1. 0-6 years _____
2. 7-10 years _____
3. 11-12 years _____
4. 1-2 years college _____
5. 2-4 years college _____
6. 5-6 years college _____
7. more than 6 years college _____

How many years of formal education have you completed? (Check one)

1. 0-6 years _____
2. 7-10 years _____
3. 11-12 years _____
4. 1-2 years college _____
5. 2-4 years college _____
6. 5-6 years college _____
7. more than 6 years college _____

## RECENT NEW PRODUCTS

Please give the approximate date (month and year) when you first bought any of the following new products (guess the date as closely as possible).

| | Date first bought (month and year) | Please check here if you have never bought the product | Please indicate if you currently use the product | |
|---|---|---|---|---|
| | | | Yes | No |
| Substitute Sausage Breakfast Links | | | | |
| Breakfast Squares | | | | |
| Blend-o-Beef | | | | |
| 100% Natural Cereal | | | | |
| Hamburger Helper | | | | |

## Part II

First read the product description card.
Next look at the product.
Then answer these questions.

"Chicken Hot Dogs" are worth every cent they cost.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I really wouldn't lose much if I bought Chicken Hot Dogs and they didn't work out as I thought.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

My husband might object if I bought "Chicken Hot Dogs."

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I really don't understand how "Chicken Hot Dogs" is supposed to work.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

"Chicken Hot Dogs" would offer real advantages over the way I presently do things.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I think if I bought and used "Chicken Hot Dogs," I would have no difficulty in telling my friend what it was like.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

"Chicken Hot Dogs" is not a product intended for a woman like me.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I have no difficulty understanding how to use "Chicken Hot Dogs."

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I wouldn't have to spend very much to buy "Chicken Hot Dogs" in order to try it out.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

"Chicken Hot Dogs" is not the sort of product I would tell my friends about after I bought it.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I would have to change some of the ways I do things if I used "Chicken Hot Dogs."

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

Please indicate by circling the appropriate response how likely you are to buy this product when it goes on sale in this area.

| | |
|---|---|
| Certain to buy | 10 |
| Almost sure to buy | 9 |
| Very probable that I'll buy | 8 |
| Probably buy | 7 |
| Good possibility of buying | 6 |
| Fairly good possibility of buying | 5 |
| Fair possibility of buying | 4 |
| Some possibility of buying | 3 |
| Slight possibility of buying | 2 |
| Very slight possibility of buying | 1 |
| No chance of buying | 0 |

First read the product description card.
Next look at the product.
Then answer these questions.

"Chicken Au Gratin" is worth every cent it costs.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I really wouldn't lose much if I bought "Chicken Au Gratin" and it didn't work out as I thought.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

My husband might object if I bought "Chicken Au Gratin."

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I really don't understand how "Chicken Au Gratin" is supposed to work.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

"Chicken Au Gratin" would offer real advantages over the way I presently do things.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I think if I bought and used "Chicken Au Gratin," I would have no difficulty in telling my friends what it was like.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

"Chicken Au Gratin" is not a product intended for a woman like me.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I have no difficulty understanding how to use "Chicken Au Gratin."

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I wouldn't have to spend very much to buy "Chicken Au Gratin" in order to try it out.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

"Chicken Au Gratin" is not the sort of product I would tell my friends about after I bought it.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I would have to change some of the ways I do things if I used "Chicken Au Gratin."

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

Please indicate by circling the appropriate response how likely you are to buy this product when it goes on sale in this area.

| | |
|---|---|
| Certain to buy | 10 |
| Almost sure to buy | 9 |
| Very probable that I'll buy | 8 |
| Probably buy | 7 |
| Good possibility of buying | 6 |
| Fairly good possibility of buying | 5 |
| Fair possibility of buying | 4 |
| Some possibility of buying | 3 |
| Slight possibility of buying | 2 |
| Very slight possibility of buying | 1 |
| No chance of buying | 0 |

First read the product description card.
Next look at the product.
Then answer these questions.

"Bonntrae" is worth every cent it costs.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I really wouldn't lose much if I bought "Bonntrae" and it didn't work out as I thought.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

My husband might object if I bought "Bonntrae."

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I really don't understand how "Bonntrae" is supposed to work.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

"Bonntrae" would offer real advantages over the way I presently do things.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

I think if I bought and used "Bonntrae," I would have no difficulty in telling my friends what it was like.

| | | | | | |
|---|---|---|---|---|---|
| Strongly Agree | Mainly Agree | Slightly Agree | Slightly Disagree | Mainly Disagree | Strongly Disagree |

Please indicate by circling the appropriate response how likely you are to buy this product when it goes on sale in this area.

| | |
|---|---|
| Certain to buy | 10 |
| Almost sure to buy | 9 |
| Very probable that I'll buy | 8 |
| Probably buy | 7 |
| Good possibility of buying | 6 |
| Fairly good possibility of buying | 5 |
| Fair possibility of buying | 4 |
| Some possibility of buying | 3 |
| Slight possibility of buying | 2 |
| Very slight possibility of buying | 1 |
| No chance of buying | 0 |

# Appendix C

## Food Service and Housing Administration
## Sample Food Evaluation Questionnaire

We'd like to begin by thanking you for taking the time to fill out this questionnaire. This will help us in our planning and preparation for future meals.

I. In this first part, would you please answer the following questions about yourself and your experiences with dining out.

A. Sex: _____M _____F

B. Marital Status:

C. Age:
20-25 _____
26-30 _____
31-35 _____
36-40 _____
41-45 _____
46-50 _____
51-55 _____
56-60 _____
Over 60 _____

D. Occupation:

E. Education: High School _____
College (no. years) _____
Technical School _____

F. How often do you eat out per month? _____ Where?

Fast food _____

Limited menu table service _____

Full menu table service _____

G. Would you please rate your familiarity with gourmet or fine dining using the following scale.

very experienced _____ _____ _____ _____ _____ very inexperienced

H. On the whole I enjoy cooking.

very much _____ _____ _____ _____ _____ not at all

II. Now, in this next part we'd like you to evaluate some of the food items you ate tonight on the quality factors listed, using the appropriate scale.

A. Onion Soup

Temperature:

Hot _____ _____ _____ _____ _____ Cold
Warm

Aroma:

Very Pronounced _____ _____ _____ _____ _____ Imperceptible
Perceptible

Overall Flavor:

Very Desirable _____ _____ _____ _____ _____ Flat
Neutral

General Acceptability:

Excellent _____ _____ _____ _____ _____ Very Poor
Adequate

Freshness:

Very Fresh _____ _____ _____ _____ _____ Very Stale

B. Chicken Normandy

Temperature:

Hot _____ _____ _____ _____ _____ Cold
Warm

Tenderness:

Very Tender _____ _____ _____ _____ _____ Very Tough
Moderately Tender

Aroma:

Very Pronounced _____ _____ _____ _____ _____ Imperceptible

Overall Flavor:

Very Desirable _____ _____ _____ _____ _____ Flat
Neutral

Texture:

Very Fine _____ _____ _____ _____ _____ Very Coarse
Moderately Fine

Appearance:

Very Pleasing _____ _____ _____ _____ _____ Very Unpleasant

Juiciness:

Very Juicy _____ _____ _____ _____ _____ Very Dry

General Acceptability:

Excellent _____ _____ _____ _____ _____ Very Poor

C. Bouchee a la Reine

Temperature:

Hot _____ _____ _____ _____ _____ Cold

Aroma:

Very Pronounced _____ _____ _____ _____ _____ Imperceptible

Overall Flavor:

Very Desirable _____ _____ _____ _____ _____ Flat

Appearance:

Very Pleasing _____ _____ _____ _____ _____ Very Unpleasant

General Acceptability:

Excellent _____ _____ _____ _____ _____ Very Poor

D. Chocolate Cake

Moistness:

Very Moist _____ _____ _____ _____ _____ Very Dry

Appearance:

Very Pleasing _____ _____ _____ _____ _____ Very Unpleasant

Texture:

Very Fine _____ _____ _____ _____ _____ Very Coarse

Overall Flavor:

Very Desirable _____ _____ _____ _____ _____ Flat

General Acceptability:

Excellent _____ _____ _____ _____ _____ Very Poor

On the whole I found this meal to be:

Excellent _____ _____ _____ Adequate _____ _____ Very Poor

# SENSORY EVALUATION OF FRESHLY PREPARED AND FROZEN-RECONSTITUTED GOURMET FOOD ITEMS AT THE PENNSYLVANIA STATE UNIVERSITY'S DIVISION OF FOOD SCIENCE AND INDUSTRY

by

Manfred Kroger, Ph.D.
Constance E. Kinard, R.D.
and
Ruth A. Hartswick

# SENSORY EVALUATION OF
# FRESHLY PREPARED AND FROZEN-RECONSTITUTED
# GOURMET FOOD ITEMS
# AT
# THE PENNSYLVANIA STATE UNIVERSITY'S DIVISION OF
# FOOD SCIENCE AND INDUSTRY

## Introduction

With frozen foods of all sorts on the increase through recent and certainly in future years, it has become natural to attempt the sale of frozen-prepared gourmet dishes. Developments in this area have, however, lagged behind those of other foods, probably because of the relatively high cost of gourmet items and because the most discriminating consumers buy them. But the hypothesis that consumers of gourmet food items can not, in fact, discern differences between freshly prepared and frozen-reconstituted items was tested in this sensory evaluation (taste panel) study. The results indicate that developers of frozen gourmet-type food items or entire frozen gourmet dinners have reason to be optimistic.

## Method

### Summary of the Design

On April 18 and again on May 8, the authors conducted organoleptic (sensory) taste panel evaluations designed to determine whether a specially trained group of subjects could measure the influence of freezing and subsequent reconstitution on the quality of certain gourmet foods. All foods were prepared and served in the Maple Room, a fine-dining environment contiguous with the food preparation laboratory of the Food Service and Housing Administration Program (FSHA) of the Pennsylvania State University's College of Human Development. For freezer storage, the Food Science facilities were used.

Preparation of the samples. The gourmet food items were prepared by various members of the FSHA undergraduate student body enrolled in FSHA 410, an advanced food preparation and food customs course. Immediately after preparation, the food samples were packaged hot in commercially available, 12-ounce, freezing-boiling bags. The bags were doubly heat-sealed, and the researchers attempted to exclude all air from the product and to distribute the food evenly throughout the bag as a thin layer to allow for effective freezing and later reconstitution.

The filled freezer bags were placed, one layer thick, on metal trays and were transported to and placed (in every case, within 60-75 minutes of the beginning of the bagging process) into a blast freezer with a temperature of -20° F. After hardening, the food sample bags were assembled the next day in cardboard boxes.

The pouches of food were stored, undisturbed, in the blast freezer for two different periods: the bouchee a la Reine, the onion soup, and the chicken Normandy remained in the frozen state for 62 days; the paté, the cream of carrot soup, the mornay sauce, the mushroom sauce, and the shrimp Portuguese remained in frozen storage for 30 days.

Immediately prior to the sensory panel evaluation the pouches were placed in boiling water. The samples remained in the water for eight minutes after the water had returned to the boiling point, except for the paté which was served at room temperature. The chicken Normandy required an additional five minutes beyond the standard eight-minute holding period.

The pouches were then cut open and the contents mixed and portioned (ungarnished, and free of any additional ingredients) for the panel members. Freshly prepared items, which constituted the experimental controls, were transported in Mason jars and insulated containers from the preparation area to the sensory evaluation facility immediately after preparation.

The freshly prepared control food items were portioned (likewise, ungarnished and without any additional ingredients) for the panel members.

Sensory evaluation. The same organoleptic panels were employed on both testing occasions. The panel was composed of 13 women from the area surrounding Pennsylvania State University. All members had been trained organoleptically and have participated together for three to ten years on various "taste panels" connected with University research. None of the panelists had any special experience with gourmet foods beyond that of the ordinary consumer, but all of the panelists had tested combination food items composed of poultry, mushrooms and dairy products.

The panelists were familiar with the "triangle" testing procedure used in this experiment, in which two like and one unlike food samples are offered for evaluation. At no time was any panelist aware of the preparation or other procedures the food samples had undergone.

The specific organoleptic panel trained and employed by the Pennsylvania State University is described this way by Dr. Joseph H. MacNeil, Professor of Food Science:

Sensory evaluation of food . . . can be explained as the translation of taste and smell stimulation into an expression of food quality. The quality could be one of flavor, texture, or color, and would be assigned some value by the taste panel judge.

Only after extensive training and experience can a panel member be counted on to give accurate and reproducible results. /But/ it has been demonstrated over and over again that reproducible results can be obtained with a properly trained taste panel. In fact, the human senses can sometimes detect much smaller concentrations of materials responsible for flavor reaction than any of the sophisticated instrumentation available to researchers.

The /Penn State/ program is under the direction of a full-time coordinator of the sensory panel. The coordinator works with the individual food scientist in scheduling evaluations, preparing samples, and arranging types of tests and analyses as required.

Panel members are selected from a group of University faculty and graduate students wives who have been tested for their ability to differentiate between various food flavors. Attempts are made to select judges having an interest in this type of research who are willing to take part in the various experiments. The majority of the panel members have had over five years' experience in taste panel evaluations and have been involved in evaluations an average of five or six times a week.

/When the Penn State panel engages in triangle tests/ the tests are usually conducted under special lighting so that any color differences in the products will be canceled out. Again, if flavor is the characteristic under consideration, it will be necessary to make sure that there are no texture differences. When the majority of the 12 panel members can identify the odd sample, one can be assured that there are differences between the samples under test.

Interpretation of data compiled by a taste panel is, of course, one of the most important aspects of the program. For example, if taste panel data are to be compared with chemical data on the same food samples, the _correlation analysis_ would provide a measure of this relationship. On the other hand, if one is interested in levels of likes or dislikes, an _analysis of variance_ of hedonic values could very well be the confirmation needed.*

The Testing Procedure for the April 18 Sampling

The classic "triangle test" was employed in this experiment. In the authoritative textbook, _The Experimental Study of Foods_, Ruth M. Griswold describes the triangle test and its advantages this way:

> [T]hree samples are presented, two of which are duplicates. The judge is asked whether there is any difference among the samples and, if so, to identify the duplicate samples. Sometimes he is also asked whether each sample is acceptable, which sample is

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* Joseph H. MacNeil. "Sensory Quality of Food Studied in New Facility," _Science in Agriculture_ (The Pennsylvania State University College of Agriculture), XXI:1 (Fall, 1973), p. 12.

> preferred, or whether the odd or duplicate samples have the distinguishing characteristics to the more pronounced degree. It is important to vary the order of presentation of the samples because judges tend to choose the central sample of the three as the odd one. The triangle test is especially useful when differences between the samples are small. Since the judge is asked to select the two identical samples from a set of three, it is possible to make three different selections, only one of which is correct. Therefore, the chance of guessing correctly is 33 percent, or once in every three trials. (1)

The procedure followed by the investigators at The Pennsylvania State University is accurately represented by this passage. Each panelist was offered three samples of each food. Two of the samples were alike (for example, either two samples had been freshly prepared or were frozen-reconstituted) and one sample was unlike the other two. Having tasted all of the samples, a panelist would (a) try to determine which samples were the like pair; (b) express a preference either for a pair of samples or for the single item; and (c) make any comments she wished about any or all of the samples.

Specifically, the frozen pouches of food were placed in boiling water, and when the water returned to a boil, the bouchee a la Reine was held for eight minutes, the onion soup was held for eight minutes, and the chicken Normandy was held for fifteen minutes.

---

(1)
(New York: Houghton Mifflin Co., 1962), p. 507.

All portioned samples, the controls and the reconstituted ones, were then placed in coded sample boards and held in a 60° C tempering oven for ten minutes. The samples were then served to the panel members (with a clean spoon for each sample) in the following order:

1. Bouchee a la Reine (No. 1-frozen-reconstituted)
2. Bouchee a la Reine (No. 2-fresh)
3. Onion Soup (No. 1-frozen-reconstituted)
4. Onion Soup (No. 2-fresh)
5. Chicken Normandy (No. 1-frozen-reconstituted)
6. Chicken Normandy (No. 2-fresh)

The Testing Procedure for the May 8 Sampling

The triangle test was again employed. The frozen pouches of food were reconstituted in the same way (that is to say, all the pouches were placed in boiling water and held for eight minutes once the water had returned to a boil). The paté, however, was allowed to reach room temperature before serving. Both the frozen and the fresh samples were placed in coded boards and then held in a 60° C tempering oven for ten minutes.

The samples were then served to the panel members in the following order:

1. Paté (No. 1-frozen-reconstituted)
2. Paté (No. 2-fresh)
3. Cream of Carrot Soup (No. 1-frozen-reconstituted)
4. Cream of Carrot Soup (No. 2-fresh)
5. Mornay Sauce (No. 1-frozen-reconstituted)
6. Mornay Sauce (No. 2-fresh)
7. Mushroom Sauce (No. 1-frozen-reconstituted)

8. Mushroom Sauce (No. 2-fresh)
9. Shrimp Portuguese (No. 1-frozen-reconstituted)
10. Shrimp Portuguese (No. 2-fresh)

## Results

The authors conducted a standard "t" test to ascertain the statistical significance of the response. The results of the two tests follow.

### The Results of the April 18 Test

1. To a statistically significant degree, the panelists were able to detect differences among all the food samples.

2. Only on the second triangle test with the chicken Normandy there was a statistically significant preference expressed, and that preference was for the fresh sample.

3. In both triangle tests of the bouchee a la Reine, a preference for the frozen-reconstituted sample emerged, but that preference was not large enough to be statistically significant. The first triangle test of the onion soup revealed a preference for the fresh sample, but the preference was not large enough to be statistically significant. No preference emerged in the second triangle test of the onion soup. The first triangle test of the chicken Normandy revealed a preference for the fresh sample, but again, it was not large enough to be statistically significant.

### The Results of the May 8 Test

1. The panelists were able to detect differences among all the food samples to a statistically significant degree.

2. Only in the shrimp Portuguese there was a statistically significant preference expressed, and that preference was for the fresh sample.

3. The cream of carrot soup and the mushroom sauce elicited a detectable, but not a statistically significant, preference for the frozen version. The panelists seemed to prefer the fresh paté, but that preference was not great enough to be statistically significant.

4. All samples of mornay sauce were equally acceptable to the panelists.

## Concluding Remarks

It is obvious that the results compiled in these experiments apply only to the effects of frozen storage and reconstitution on the particular foods considered in this study. Other gourmet foods, even if prepared in a simillar manner, held in frozen storage for various periods and evaluated by other panels might elicit different results.

Nevertheless, the study at hand seems to support the hypothesis that at least some gourmet foods can be frozen in relatively large quantities for commercial use without any appreciable quality loss. It must be borne in mind, however, that the students involved in the preparation of the food for this study were not professionals or practicing chefs. Moreover, they were preparing certain unfamiliar foods for the first time. The Maple Room and the adjoining FSHA laboratory, while certainly adequate for college courses in food preparation, do not provide the sort of controllable, routinized food preparation environments available to commercial food processors.

The panelists responded favorably to all food samples. Their preferences for two of the samples of fresh gourmet food were slight, though measurable.

Future studies are in order to support these findings, particularly with variations in experimental design, such as frozen storage time, the food involved, and panel members. Further supporting data would definitely pave the way for the general applicability of the concept and feasibility of marketing frozen gourmet dishes.

# THE POTENTIAL IMPACT OF NUTRITION DELIVERY SYSTEMS ON FOOD NUTRIENT RETENTION:

## RESULTS OF A PILOT STUDY

by

Ira Wolinsky, Ph.D.

Constance Kinard, R.D.

Coleen P. Greecher, M.S., R.D.

and

Manfred Kroger, Ph.D.

# THE POTENTIAL IMPACT OF NUTRITION DELIVERY SYSTEMS ON FOOD NUTRIENT RETENTION:

## RESULTS OF A PILOT STUDY

### Objective

This pilot study was designed to determine the effects of steam table "holding" on the nutritive value of foods typically prepared for mass feeding programs.

### Rationale

The agrarian tradition of three meals a day eaten with the gathered family is nearly extinct. More people are finding it easier for a number of reasons (for example, convenience, time, mobility, expense) to eat at restaurants, institutions, cafeterias or schools. The nutrient value of the food prepared in such institutional meals is becoming an issue of concern. As more knowledge is gained by the food service industry, as well as by consumers, the nutritive value of foods will be more critically examined. And there is certain to be a demand on the part of the public for nutritional quality.

This pilot study was undertaken to gather information as to what effects a certain preparation procedure, steam table holding, has on nutrient quantity.

The information gained from this preliminary study will serve as a basis for further study in this area. If research suggests the necessity, further study might help to improve nutrient retention in foods prepared for mass feeding.

## Plan

Two foods, chicken and green beans, typically prepared in institutional settings, were chosen for this study. The foods were prepared according to a standardized method (described later) and were held at various temperatures to determine the destruction of selected nutrients. Two vitamins were chosen--ascorbic acid in the vegetable and riboflavin in the meat. Ascorbic acid was chosen because it is very heat labile and because the assay is easily and accurately performed. The presence of ascorbic acid in a heat processed food is a good measure of the severity of the heat process and has often been used as an index of general nutrient content in foods just because of this lability. Riboflavin was chosen for assay, not because it is particularly heat labile, but because facilities for testing were readily available.

This study was initiated as a result of an investigation summarized in 1974 as a part of the "Food Service Futures Project," which identified a general lack of information on the effects of holding large quantities of food.

## Holding Animal Foods

Few studies have been conducted on the nutritive losses during large scale preparation of foods of animal origin. Studies that are available (5) state that losses were found to be due to 1) fat trim, 2) thaw juices, 3) presoaking, 4) cooking, 5) pan drippings, 6) holding on a steam table, 7) holding in a refrigerator, and 8) reheating after holding. In 1948, Westerman (14) found that 91 percent of the thiamin content in sliced roast pork was retained during holding over boiling water for thirty minutes.

On the basis of studies to determine thiamin and riboflavin content, Erikson and Boyden (4) found that reheating turkey and holding it on a steam table had no significant destructive effect on B vitamin content.

## Retention of Nutrients in Vegetables

It is common practice to hold cooked food on hot plates and steam tables for as long as one, two, or three hours until serving. Most likely, the main cause of nutrient losses in this situation is by oxidation. Harris (6) has compiled an extensive table of nutrient losses of vegetable products held on steam tables for varying lengths of time. Ascorbic acid was by far the most strongly effected nutrient in the studies conducted on snap beans, cabbage, carrots, cauliflower, kale, peas, potatoes, spinach, squash, and turnips. Losses ranged from 11 percent in boiled and held cabbage to 94 percent in peas held hot for three hours. Thiamin appeared to be the next most highly labile nutrient. A four-percent loss was noted in red cabbage held hot for three hours as opposed to a 74-percent loss in cabbage cooked for seven minutes. The wide variation in amounts of nutrients lost can probably be explained by the severity of heat employed, by differences in vitamin assay procedures, and by differences in experimental methods.

A report by Livingston et al (9) found that significant losses of vitamins A and C can occur when hot cooked foods are placed in insulated food carriers that maintain the food at hot temperatures for several hours. The same research group found that vitamins A and C in foods held chilled for 72 hours then heated to serving temperature were considerably lower than losses in food held hot for three hours.

Beef, thoroughly cooked and chilled, was sliced and reheated. This resulted in a 68-percent thiamin retention as opposed to a 79-percent retention in beef held for 90 minutes and then sliced. A possible explanation for this is the greater oxidation due to the increased surface exposed during reheating (2).

Kahn and Livingston (7) analyzed several fresh dishes and their frozen counterparts for thiamin retention. They observed that thiamin losses for all the dishes were greater when the products (beef stew, chicken a la king, shrimp newburg, and peas in cream sauce) were freshly prepared and held hot for one, two, or three hours, as opposed to preparing and immediately freezing the foods for reheating with infrared or microwave techniques.

LaChance et al (8) added varying amounts of ascorbic acid and thiamin to chicken pot pie fillings to investigate the effects of heating and steam table holding on nutrient retention. Heating resulted in a total vitamin C loss of from 9 to 23 percent. No further loss was noted when the samples were held for 30 minutes under steam table conditions. Thiamin losses due to steam table holding were increased approximately 11 percent.

A pilot study was performed to investigate the effects on ascorbic acid content of frozen broccoli of conventional steaming and holding on steam table versus thawing at 3.3° C and reheating in a convection oven (12). Ascorbic acid content was determined by the indophenol method. The results follow:

Table I

Effects of Preparation Methods on Ascorbic Acid (A.A.) Content of Broccoli

| | mg. A.A./g Broccoli | % of Total A.A. | % Loss |
|---|---|---|---|
| Frozen | 0.64 | 100.0 | -- |
| Steamed | 0.50 | 78.5 | 21.5 |
| Steamed - Held 30 Minutes | 0.36 | 56.0 | 44.0 |
| Steamed - Held 60 Minutes | 0.20 | 31.7 | 68.3 |
| Thawed at 3.3° C | | | |
| Reheated in Convection Oven | 0.47 | 72.5 | 27.5 |

Although this study represents only one example, it points out the need for more work in this area. If significant nutrient loss occurs in standard institutional procedures, new processes should be introduced.

Besides affecting nutrient retention, the holding of prepared foods also affects their color, consistency, and flavor--and it determines the total quality of the food product. Since this is the case, the future will probably see a move away from holding methods towards systems methods that require heating immediately before serving, microwaves, infrared heating, or some other form of energy use (1).

Methods developed to prevent excessive holding of foods in heated containers for transport (or on steam tables) have been reported to result in a greater retention of ascorbic acid (ascorbic acid was chosen because it is one of the most labile nutrients.) The "Cook Freeze" system was developed to allow for central preparation and freezing, distribution to satellites of frozen cooked food, and reheating on site. This method avoids holding foods in insulated containers to maintain serving temperatures. If appropriate cooking procedures are employed, preparation of food by this method probably retains nutrients. It has been claimed that the cook-freeze system increases the retention of ascorbic acid due to greater control over the heating stages in preparation (11). But no exact data is available on the amounts of ascorbic acid retained.

## Methods

The percentage of moisture present in the vegetable and meat being assayed was determined as follows:

Meat. After roasting, a 20-gram sample of meat was held uncovered in a drying oven at 100° C. After seven hours, the dried sample was weighed and the percentage of moisture was calculated.

Vegetable. After draining and weighing, a 50-gram sample was held in a drying oven at 100° C. After seven hours, the dried vegetable sample was weighed and the percentage of moisture was calculated.

## Preparation of Samples and Methods of Analysis

Three basic procedures exist for the determination of riboflavin in meats and meat products: biological rat assay procedures, microbiological procedures, and *in vitro* fluorometric methods. The biological procedures have been found to be expensive and time consuming, and the availability of riboflavin is sometimes questionable. The microbiological method is criticized because extracts of certain biological material may exert either inhibitory or stimulatory effects on the riboflavin procedure. The fluorometric method sometimes results in problems due to excessive turbidity of the extract or the presence of extraneous fluorescent material in solution.

For the purposes of this study, the fluorometric method was deemed most suitable.

Conner and Straub (3) developed a fluorometric method for use with plants. The procedure was modified by Peterson _et al_. (13) for use with animal products. The procedure follows:

Raw boneless chicken breasts, purchased on the local market, were roasted uncovered in a 350° F oven to an internal temperature of 195° F. Four 20-gram samples were obtained from each chicken breast for riboflavin analysis. Two samples were held, uncovered, over a water bath at 60° C for two, four or six hours to simulate steam table conditions. The samples were then analyzed for riboflavin. The other samples were analyzed for riboflavin with no further treatment.

## Analysis

A 20-gram sample was dropped in 100 ml of 0.04 N $H_2SO_4$ in a Waring blender and macerated for two minutes at high speed. Following complete maceration, the blended mixture was transferred to a 250 ml Erlenmeyer flask. The flask was plugged with a foil covered stopper and autoclaved for 15 minutes at 15 pounds pressure. After the flask was completely cool 20 ml of a 2.5-percent clarase enzyme solution was added. (The clarase solution was freshly prepared in a sodium acetate-acetic acid buffer.) After thorough mixing, the flask was incubated at 45° C for 24 hours. From this point on, experimentation was performed in a darkened laboratory. The extract was brought to a volume of 200 ml in a graduated cylinder. After complete mixing, the extract was filtered into glassware. Five ml of the filtrate were pipetted in each of two matched cuvettes, A and B. Five ml of distilled water were added to tube A, 5 ml of an aqueous riboflavin solution containing 0.2 mcg/ml were added to tube B. The solutions were carefully mixed. Fluorescent readings were made on a Coleman spectrofluorometer after the instrument was calibrated with sodium fluorescein solution of 125 mcg/l adjusted to 100 on the instrument's scale. The aqueous riboflavin solution read approximately 70. (This was thought to be a suitable range for the meat samples.) A volume of 0.5 ml of sodium hydrosulfite solution was added to tubes A and B. The tubes were read on the spectrofluorometer, and an average of the two readings constituted the sample blank or "C" reading.

### Ascorbic Acid Analysis

Many methods have been developed for assaying vitamin C. The ascorbic acid assay method chosen for this study is a modified version of a photoelectric colorimetry method, using indophenol dye. It was chosen for its suitability to the product, its relative accuracy, the availability of necessary assay materials, and for the conservation of time allowed by use of this procedure. This particular method, adopted from Loeffler and Ponting (10), follows:

Canned green beans (Del Monte Blue Lake), purchased locally, were drained and weighed into 50-gram portions (dry weight). The portions of beans were placed in uniform containers at a depth of 1-1/4 inches, and were steamed to a temperature of 60°. Immediately after steaming, some beans were assayed for ascorbic acid. Some samples were held over a water bath at 60° for two or four or six hours and then analyzed for their ascorbic acid content.

Analysis was the same for each sample. A 50-gram sample was blended in a commercial Waring blender with 350 ml of 1 percent metaphosphoric acid and macerated for five minutes at high speed. The extract was filtered and 1 ml portions were pipetted into three matched Spectronic -20 tubes. Nine ml of distilled water was added to each tube. The colorimeter was adjusted to 100 with this tube. Nine ml of standardized indophenol dye was added to each of the other two tubes with a rapid delivery pipet. Fifteen seconds after the start of dye addition, colorimeter readings were taken.

## Results

The results of this experimentation follow in tabular form.

Table 2. Moisture Determination

| | Dry Weight | % Moisture |
|---|---|---|
| Chicken Breast | 7.66 gms. | 61.7 |
| Green Beans | 3.50 gms. | 93.0 |

Table 3. Riboflavin Content of Chicken
Held for Varying Times Under Simulated Steam Table Conditions

| | Riboflavin Conc. (mcgm./gm. dry weight chicken) |
|---|---|
| Roasted to 195° F | 1.64 |
| Roasted, held 2 hours | 1.86 |
| Roasted, held 4 hours | 1.89 |
| Roasted, held 6 hours | 1.80 |

Values given are an average of four samples. Total percentage change in riboflavin concentration from assay immediately following roasting to assay after six hours of holding was 10%.

Table 4. Ascorbic Acid Concentration of Green Beans
Held for Varying Lengths of Time Under Simulated Steam Table Conditions

| | Ascorbic Acid Conc. (mgc/100 gm. dry weight beans) |
|---|---|
| Drained, Steamed | 35.7 |
| Drained, Steamed, Held 2 hours | 24.6 |
| Drained, Steamed, Held 4 hours | 15.2 |
| Drained, Steamed, Held 6 hours | 8.2 |

Each value given represents an average of five samples. Total percentage of ascorbic acid concentration lost, from steaming to holding 6 hours, was 77%.

## Discussion

The concentration of riboflavin in a food of animal origin was found to be relatively stable after up to six hours of holding under steam table conditions. All the riboflavin assay values were within the normally expected range of variation between food samples; no significant loss of the riboflavin content appeared during varied periods of holding under these conditions.

Results, after two, four and six hours of holding, are probably due to the relative stability of riboflavin when exposed to heat. The chicken samples were held under steam table conditions, uncovered, and exposed to light during the entire holding process. This was thought to simulate most accurately actual steam table holding. Apparently exposure to light also caused very little variations in riboflavin concentrations of the samples.

Thiamin is considered a very heat labile vitamin. Though thiamin assay was not part of this pilot study, one would expect, because of its extreme lability, that this treatment method would result in a significantly decreased thiamin content in food samples held for extended periods under steam table conditions.

The concentration of ascorbic acid in green beans was found to be inversely related to the time held on the steam table. These findings are in agreement with those of Palmer (12), although the present study employed more rigorous holding techniques than Palmer's. The total loss of ascorbic acid from the steamed-only sample to the steamed and held-six-hours sample was 77 percent, a significant loss.

Vegetables are often held from one to three hours on a steam table before serving. Therefore, the six-hour holding period is probably not representative of common institutional practices. That period was included to determine ascorbic acid losses under the most extreme conditions. The holding times of two to four hours are more in line with actual institutional practices. Losses resulting from holding were 31 percent after two hours and 57 percent after four hours. These are significant losses, especially if green beans are depended upon as a significant source of vitamin C.

Overall, this investigation served as a pilot project for the purpose of investigating preparation and assay methods and to determine nutrient losses approximately as a result of holding foods under steam table conditions. The next segment of this investigation will involve following exact preparation and distribution methods of a particular mass feeding program. The program to be investigated utilizes central preparation facilities and employs holding foods for distribution to satellite areas. It is of interest to determine the extent of nutrient loss due to these procedures in an actual feeding operation, rather than relying only upon isolated laboratory tests.

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# SEVEN FOOD PROCESSING AND PREPARATION HEAT TRANSFER EXPERIMENTS

by

Frank W. Schmidt, Ph.D.

and

Stephen Bartlett, M.S.

# SEVEN FOOD PROCESSING AND PREPARATION HEAT TRANSFER EXPERIMENTS

A series of very simple experiments have been developed to illustrate some of the basic principles of heat transfer important to those working in the food processing and preparation industries. Casual observations have made us aware of many of the phenomena, but by careful experiment one can observe the phenomena in an orderly manner and gain some insight into actual temperature drops and rates of heat transfer. Except for experiment 7, the only instrumentation required is a mercury and glass thermometer. All of the other containers and equipment needed are readily available in any domestic or commercial kitchen.

## Experiment I: The Effect of Surface Area on Rate of Heat Transfer

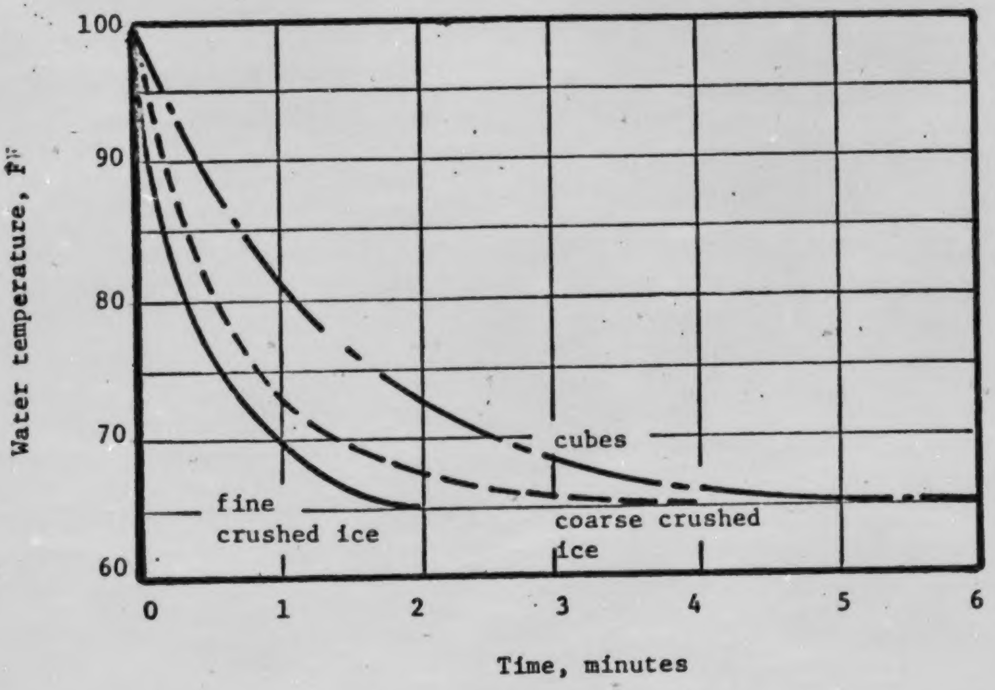
### Objective

The objective of Experiment I is to show that the rate of heat transfer is proportional to the area of material exposed to the surroundings.

### The Experiment and the Results

Individual containers of water, each at the same temperature, have an equal amount of ice added. In one container, the ice is in cubes; in another, it is in smaller pieces; in the other, the ice is crushed. Place the ice in the container and record the temperature of the water every 30 seconds using the thermometer to mix the ice water solution. The results of this experiment appear in Figure I below.

Figure I. A Graph of Experiment I



Discussion

The smaller the particles of ice, the more rapid the decrease in temperature. This result is due to the fact that there is more ice surface exposed to the water across which heat can be transferred to the ice. A one-inch cube of ice has a surface area of six square inches. But if the cube of ice was quartered to yield four one-half inch cubes of ice, a total surface area of crushed ice will be much greater. The high rate of heat transfer for crushed ice reduces the temperature of the water faster and the ice melts quicker than for the single cube of ice. If the three containers are well insulated, the final temperature of the water will be the same in all three cases since the initial temperature of the water is constant and the amount of ice added to the identical containers is equal.

## Experiment 2: Natural and Forced Convection

### Objective

The object of Experiment 2 is to show the effect of the movement of the surrounding fluid on the rate of heat transfer.

### The Experiment and its Results

Expose four identical ice cubes to different environments, but all at room temperature. Two cubes are exposed to air, one in still air (natural convection) and the other in front of a fan to blow the air across the ice, (forced convection). The other two cubes are placed in containers of water, one at rest and the other stirred gently. Measure the time it takes for each ice cube to melt completely. The results appear in Table I, below.

Table I. Melting Times of Four Ice Cubes in Four Environments

| Condition | Melting Time, in Minutes |
|---|---|
| Still air | 73 |
| Moving air | 27 |
| Still water | 10 |
| Moving water | 3-1/2 |

## Discussion

Equal amounts of heat are required to melt the ice cubes, thus the test with the shortest melting time must have the highest heat transfer rate. The forced movement of the fluids by a fan or by stirring increases the mixing action and allows warmer fluids to come in contact with the ice thereby increasing the rate of heat transfer. When the ice is in still air or water the movement of the fluid is much slower and is affected by the buoyancy effect resulting from the tendency of hot fluids to rise upward and cold fluids to move downward. For the cases tested, it takes three times longer for the ice in a still fluid to melt than when it is placed in a moving fluid.

The rate of heat transfer also depends on the density and specific heat of the surrounding fluid. Water has larger values of these two properties than air, thus the ice in water melts from 7 to 8 times faster than the ice in air.

## Experiment 3: The Relationship Between Total Heat Transfer and the Mass of a Substance

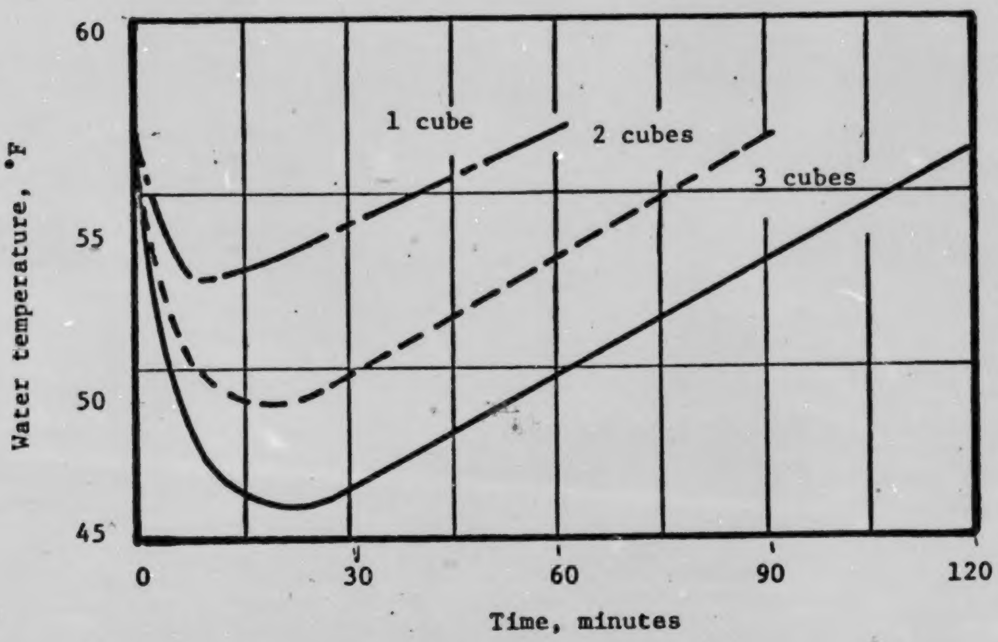
## Objective

The objective of Experiment 3 is to show that the amount of heat required to have a specific effect on a given material is proportional to the mass (or volume) of that material.

## The Experiment and the Results

Three identical containers are filled with water at the same temperature. To each container, a different number of ice cubes are added. The water temperature is measured to determine the rate of temperature change and the lowest temperature reached. The results of Experiment 3 appear in Figure 2.

Figure 2. The Results of Experiment 3



Discussion

During approximately the first ten minutes, the water temperature in all three cases decreases rapidly to its lowest level. The faster rate of decline with more ice cubes is not due so much to the different weight of ice, but to the amount of ice surface area exposed to the water.

Once the water temperature drops below the temperature of the air surrounding the container, heat is transferred from the air to the water.

During the period of declining temperature, heat from the water is transferred to the ice, melting it at a faster rate than heat is being absorbed through the container from the surroundings. The constant-temperature period indicates that the heat absorbed from the surroundings is balanced by the amount of heat absorbed by the melting ice. Once the ice has melted completely, it no longer absorbs heat, but heat is still being transferred to the water from the surroundings. This causes the temperature of the liquid to rise and it will eventually reach the same temperature as the surroundings.

The masses of ice added to the various water baths determine how low the temperature will drop and how long it will stay below a specific temperature, say 55° F. The greater the number of ice cubes, the more total heat must be transferred from the surroundings, increasing the low-temperature time span.

Adding more ice to decrease the water temperature will work only to a certain point. The water temperature will approach the freezing point, but drop no lower. More ice cubes will still maintain the low temperature, but for a longer period.

## Experiment 4: Heat Loss from Uncovered Containers

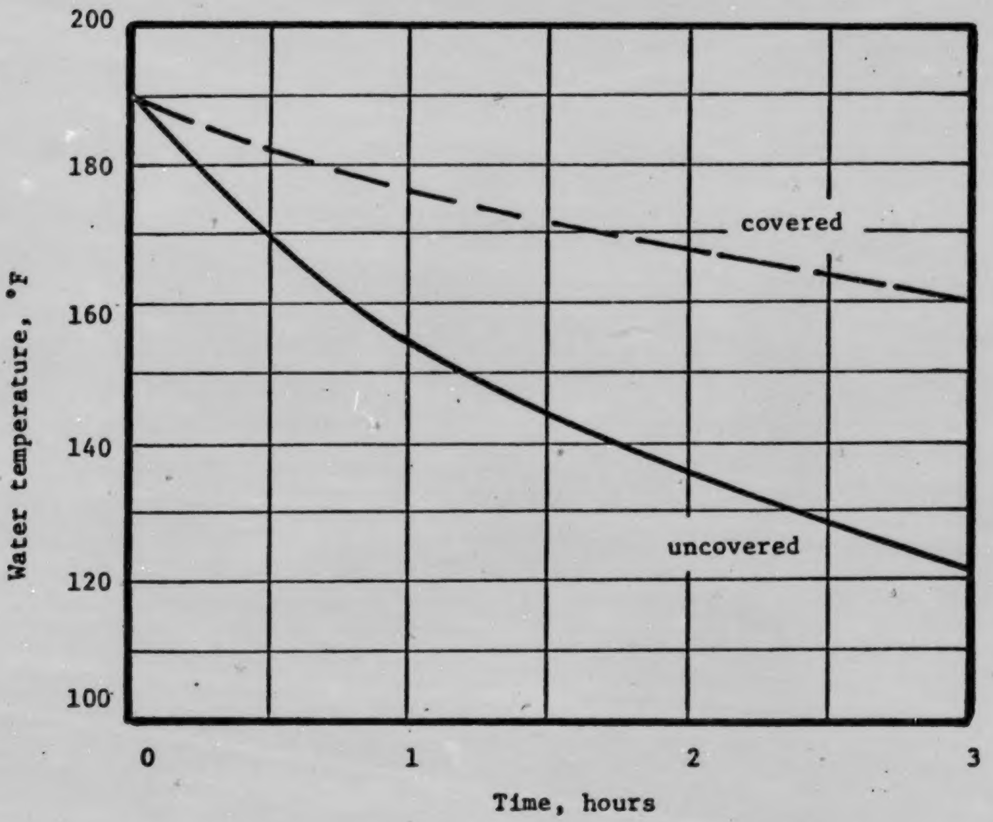
### Objective

The objective of Experiment 4 is to show that the heat transfer rate from an uncovered container is less than from a covered container.

The Experiment and Its Results

Two identical thermos bottles are preheated with hot water. Then they are filled with equal amounts of hot water at the same temperature. One thermos is covered, and the other is left open. The water temperature in both containers is monitored to show the difference in heat transfer rate. The results of Experiment 4 appear in Figure 3.

Figure 3. The Results of Experiment 4



Discussion

It is evident from the graph that any area of a container that is uninsulated will allow faster heat transfer than a more thoroughly insulated container. The uncovered container loses heat at a much faster rate than a covered one, as shown by the higher rate of temperature drop for the uncovered container. A cooking practice which makes use of this phenomenon is to use covers on pots and pans to slow down the heat transfer from the hot food to the atmosphere, thus reducing the energy consumed in raising the food to a given temperature.

## Experiment 5: Preheating and Precooling of Containers

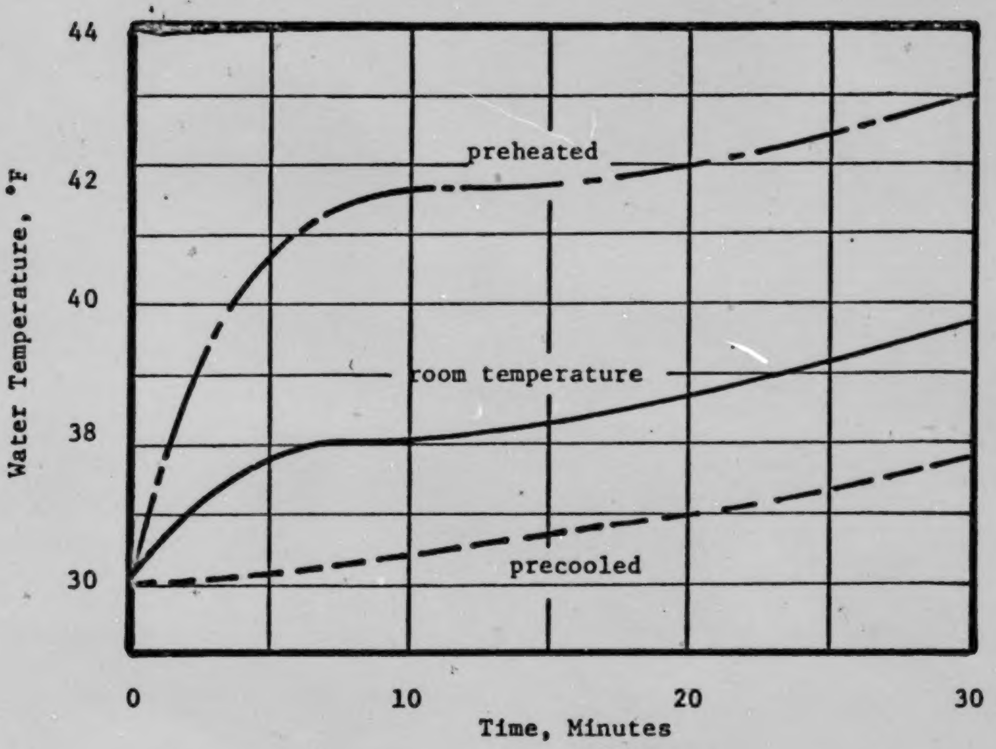
### Objective

The objective of Experiment 5 is to show that preconditioning a container to the temperature of the material to be introduced into it prevents excessive heat transfer between the material and container and reduces or eliminates the initial temperature change of the material.

### The Experiment and its Results

Three identical thermos bottles are used. One is preheated by filling it with hot water and allowing it to stand awhile. A second remains at room temperature. And the other is precooled by allowing it to stand for a time filled with ice water. The preconditioned containers are emptied and all three are filled with equal amounts of ice water. The temperature of the water is measured at intervals to determine how it changes with time. The results of this experiment appear in Figure 4.

Figure 4. Results of Experiment 5



## Discussion

Although all containers were insulated, preventing transfer of heat from the surroundings to the water at a rapid rate, the containers that were not precooled exhibited a greater temperature rise during the first ten minutes than the precooled thermos. This result is due to the fact that heat was being transferred from the thermos itself to the water until they both reached the same temperature. The preheated container has more heat energy stored in it, so more heat was transferred to the water, and its temperature was raised farther than the water in the other containers.

Note that after the first ten or fifteen minutes, the rate of the temperature rise is relatively slow and roughly equal for all containers.

This temperature increase is due to heat transfer from the surroundings to the water. The rate of heat transfer is proportional to the temperature difference between the water and the surroundings.

It can be seen from this experiment that placing cold material into a container which has just been washed with hot water will cause a significant increase in the temperature of the material in a relatively short time. A similar case exists when hot material is placed in a cold container. In order to prevent this rapid temperature change initially, the container should be preconditioned to the temperature of the material to be introduced into it.

## Experiment 6: The Effect of Insulation

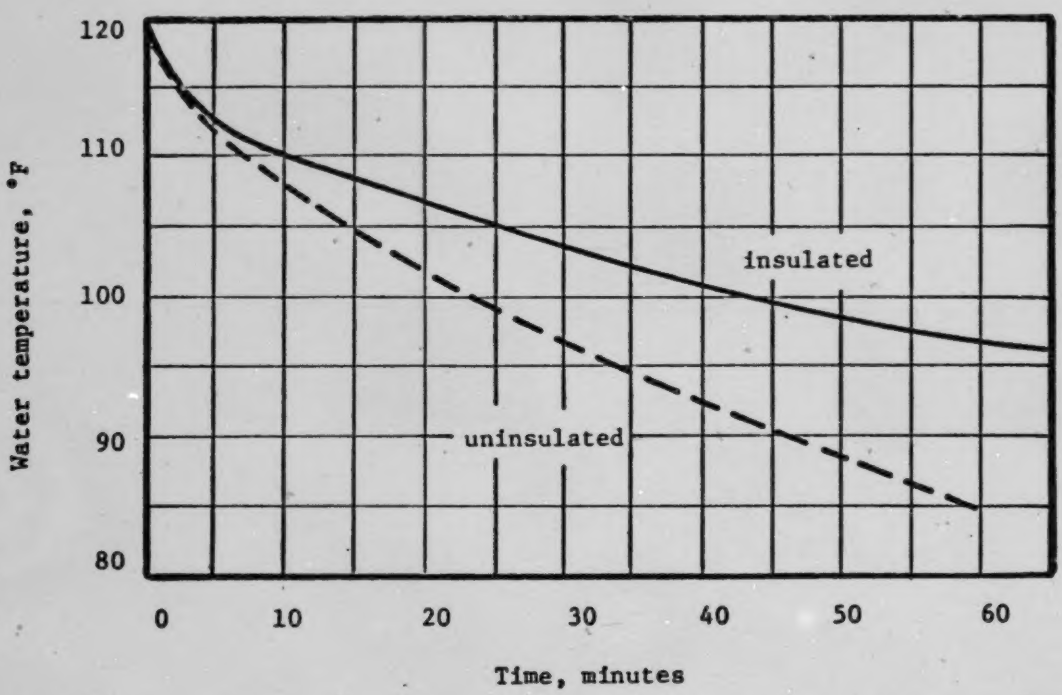
### Objective

The objective of Experiment 6 is to show that insulation decreases the rate of heat transfer to or from material in a container.

### The Experiment and its Results

Two identical containers are used, one insulated, the other not. A glass or metal container can be insulated by placing it inside a small cardboard box and filling the space between the container and the box with cotton balls. The containers are filled with equal amounts of water at a specific temperature, either hot or cold. Measure the water temperatures for a period of time to determine which container slows the heat transfer rate to or from the water. The results of this experiment appear in Figure 5.

Figure 5. The Results of Experiment 6



Discussion

This experiment shows the value of insulation in maintaining material within a container at a high or low temperature. If the heat transfer rate to the surroundings can be kept low enough, energy and equipment are not required to maintain the temperature within limits for long periods. If they are still needed the amounts required will be less in the insulated case.

## Experiment 7: Thermal Conductivities of Different Materials

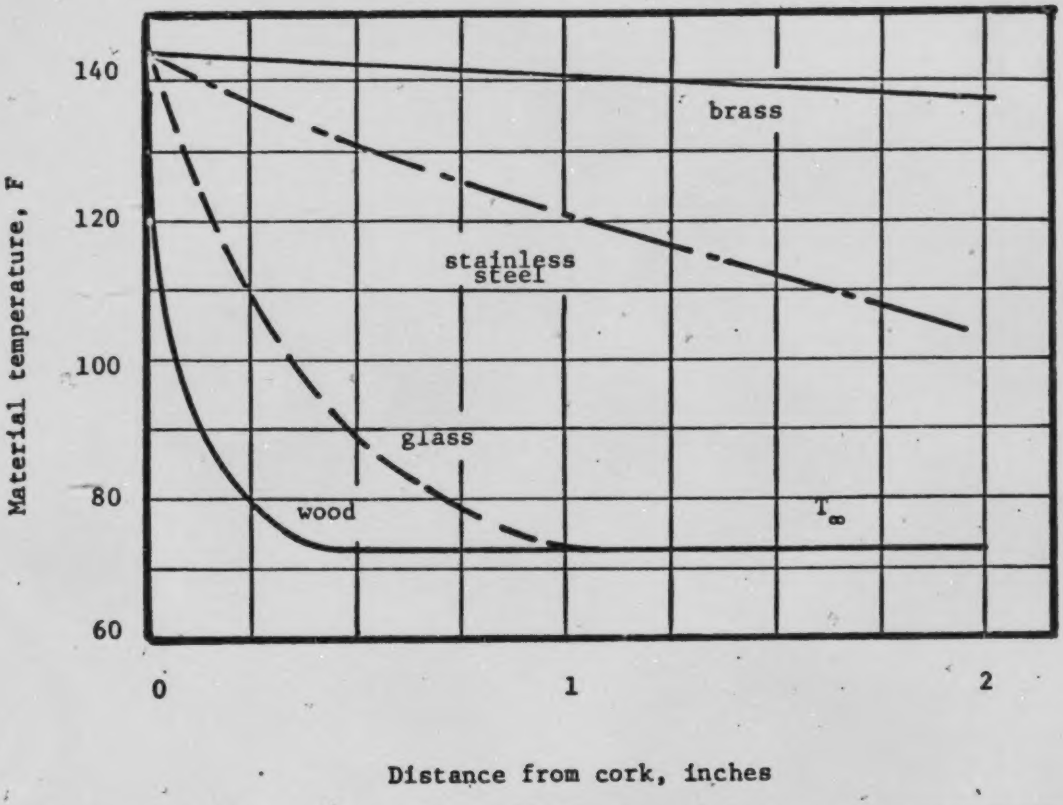
### Objective

The objective of Experiment 7 is to show that some materials are better conductors of heat than others.

### The Experiment and Its Results

Water is placed in an insulated container and a cork with several small holes is placed on the container mouth. Rods of different materials are placed in the holes with part of the rods immersed in hot water and with identical lengths of all rods exposed to the surroundings. Temperatures are measured at various distances from the heated parts of the rods to show which are the better heat conductors. The temperature measurement at specific locations can be made using thermocouples attached to the surface or by placing on the surfaces temperature sensitive waxes. (These waxes are available from Thermal Co., P.O. Box 5327, Huntsville, Alabama 35805). If this equipment is unavailable one can easily tell by touch the relative values of the temperatures of the rods. The results of Experiment 7 appear in Figure 6.

Figure 6. The Results of Experiment 7



Discussion

Note that the rods register drastically different temperatures at a given distance from the heated section. Good conductors allow heat to flow readily through their material rather than into the surrounding air. This means that the temperature does not drop as sharply with increased distance from the heated section as with an insulator. An insulator blocks the flow of heat through the material and instead transfers it to the surroundings. Therefore an insulator shows a sharp temperature drop as the distance from the heated area increases.

Note that nonmetals in general are poor conductors of heat while metals are generally good conductors. Note too that a considerable difference may exist between two metals such as brass and stainless steel. When stirring a hot liquid with a sterling silver spoon, one notices that the handle gets very hot. But the handle of a stainless steel spoon will not rise to as high a temperature under similar conditions. Because wood and plastic are even better insulators, they are generally used on the handles of utensils that will be exposed to high temperatures.

# SYSTEMS FOR CONTROLLING THE PHYSICAL ENVIRONMENT
# OF
# FOOD SERVICE ESTABLISHMENTS:
# A LOOK AT THE FUTURE

by

Charles T. Morrow, Ph.D.

# SYSTEMS FOR CONTROLLING THE PHYSICAL ENVIRONMENT OF FOOD SERVICE ESTABLISHMENTS: A LOOK AT THE FUTURE

## Introduction

An investigation has been conducted of systems for controlling the physical environment in food service establishments and the probable trend and changes that will occur in the next ten to fifteen years. Of particular concern in this survey were heating, air conditioning, and ventilation systems; lighting systems; waste management systems; food preparation systems; and energy sources required for all of these areas.

To achieve a look at the future in physical environment systems, the author took several approaches. He surveyed recent engineering and hospitality literature in an attempt to determine technological changes that conceivably will affect the future of physical environment systems. A selective bibliography of the literature obtained from this study is included with this report.

The author also contacted a number of manufacturers of equipment in an effort to learn any trends which they foresee which would significantly change the types of systems currently being used in food service establishments.

In order best to evaluate future trends, each of the previously mentioned areas of the list will be considered separately. It is quite possible that technological and sociological changes may result in a shifting of apparent future trends, but this report represents an opinion as to the probable future of food service physical environment equipment.

## Future Energy Sources

There is no doubt that this nation faces a future crisis in energy sources. Whether the shortage is contrived or not, the United States is short of fuel. If an immediate attempt is not begun to stop the waste of energy, the affluence of every American will probably be affected substantially in the next decade. The conservation of energy also makes good economic sense in that it could result in a substantial increase in profit and return on investments.

To understand why energy conservation is so vital in the overall energy problem that the nation will face in a few years, consider facts prepared by the office of Emergency Preparedness of the White House. One quad of energy is equivalent to one quadrillion BTU. To consider the magnitude of this unit of measure, consider the fact that all of the energy consumed in the United States during 1970 totaled 70 quads. This figure included gas, oil, coal, and electrical energy from all sources including nuclear and hydro. It is not difficult to project national future energy demand based upon the historical trend, the current rate, and the projected population, and industrial activity. A projection plot of historical data indicates that slightly more than 100 quads of energy will be required in 1980. This level is probably the minimum that will be required (it is possibly a little low) unless substantial new mechanisms come into play.

Similar projections have been made with regard to availability of energy in all forms in 1980. These projections indicate that, at most, we can expect to provide 94 quads from all sources. Obviously, this is 6 quads or 6 percent short of the estimated demand.

This estimate assumes (1) all economically feasible sources including the northern slope of Alaska; (2) maximum importation of liquified natural gas and oil; (3) aggressive exploration and development of new domestic sources; (4) synthetic natural gas from coal; and (5) the construction of new nuclear plants essentially on schedule. Realistically, the 1980 shortage will probably reach at least 10 quads. The solution, therefore, is obviously energy conservation. Waste of energy must be stopped so that this country will not be short of energy in 1980 or beyond. In total, means must be found to conserve at least 10 quads of energy that would otherwise come from conventional fuels in 1980.

The implications of this conservation to the food service industry are numerous. While the food service industry does not constitute a large segment of the total energy use, it is still very important that new installations and existing operations are cognizant of ways to conserve energy. One of the trends that will probably become much more prevalent is the use of energy consultants to minimize costs in the operation.

By means of better management practices, it is conceivable that energy use can be reduced in many food service operations. For instance, habitation temperatures that are currently maintained in many operations can conceivably be somewhat reduced. It is also quite important to only provide environmental controls in those areas of a food service operation where they are absolutely essential. In some cases, worker comfort may have to be sacrificed to a slight degree in order to reduce total energy requirements. Systems for heating, air conditioning, and ventilation may not only become more efficient but also may in fact provide somewhat less desirable atmospheres than has been traditional. New techniques like evaporative cooling that have traditionally not been used in many parts of this country are probably going to become somewhat more important in future years although they may not result in as much comfort as conventional air-conditioning systems.

It is doubtful that such new energy sources as solar inputs are going to have a significant impact on the food service industry. Equipment technology is currently such that no major technological developments are anticipated in the next 15 years that would significantly affect food service operations. In some cases, it may be possible to use solar sources as a supplement. Requirements for energy reduction such as the use of cooling towers for steam plants in many food service operations are extremely costly but may, in fact, be necessary due to environmental and municipal regulations. Whenever possible, the design of a new food service establishment should include maximum flexibility for changes in energy sources.

It is anticipated that many food service operations will purchase steam directly from municipal manufacturing plants in the future rather than provide their own local generation. This purchase of secondary energy sources is necesary because of many environmental restrictions and cost factors. It must be realized, however, that there is going to be an enormous cost associated with the purchase of secondary energy. It is extremely essential, however, that food service operations continue to conserve energy both by design and operation to as large a degree as possible.

Natural gas shortages are going to affect energy available to many operations significantly. It is anticipated that electricity will continue to be used to a much larger extent in many installations; but heating, cooling, and food preparation equipment should be designed so that an alternate energy source can be substituted if such a substitution becomes economically desirable--or required.

In summary, major developments in the food service industry from the viewpoint of energy implications are probably going to take the form of better installation design and maintenance techniques primarily. No extensive technological developments are anticipated that would significantly affect the nature of these food service installations.

## Waste Management Systems

The subject of waste management disposal or treatment systems for use in food service installations is quite involved at the present time. Depending upon the location of a particular food service operation, the requirements for waste management depend to a large degree upon local codes and state and federal environmental protection regulations.

Most operations of any size will probably need to include some type of trash compaction systems in future installations. By means of on-site trash compaction operations, the volume of waste material that must be handled can be tremendously reduced. This reduction is beneficial from the food service viewpoint in that it lessens storage requirements, requires less frequent solid waste pickup, and presumably reduces handling costs to the food service operation. In addition, compaction systems offer the advantage of providing better sanitation in that the waste materials can be consolidated quite conveniently.

Depending on the size of the operation, waste management compaction systems will probably also include some degree of separation capability. Units already available remove silverware and similar material from waste; they are quite justifiable in large food service installations. Removal of solid from liquid waste matter depends on the nature of the installation. In most cases, however, local codes are probably going to require that some degree of separation of waste matter be possible in food service operations.

Waste water may be reused in some operations by means of filtration and similar techniques. But such a reuse of waste water will probably not become realistic in the next few years. In order effectively to reduce the problem of waste management and disposal, more efficient means of reducing waste matter generated must be explored. Several water reduction systems are being considered for use in installations in such areas as lavatories and kitchen operations. Dish washing systems, which are more efficient from the viewpoint of water use and management, obviously need to be considered. Any means possible to reduce the amount of total waste output is quite obviously very desirable to the food service operator. Packaging techniques are also of significance from the viewpoint of waste material which must be removed. Buying food materials in larger quantity bulk packaging has advantages not only from the viewpoint of economy but also because of the amount of waste matter that must consequently be removed.

While the concept of returnable packages and pallets and other handling mechanisms seems to offer some possiblity, a major change in returnable packaging is not likely to be forthcoming in the next few years. The logistics of returning the packaging materials and the sanitation considerations present many problems with the present available technologies.

Experiences with recycling such materials as glass bottles have not been totally satisfactory. Again, the problem is primarily one of logistics and of storage and separation facilities. Ideally, it should be possible to separate all reusable materials from food service refuse, but in the practical sense, the separation becomes extremely costly and time consuming. It is, therefore, expected that instead of changes in types of waste management systems, the future will see a gradual trend to better efficiency of operation and less waste matter generated during the entire food production and service chain.

## Heating and Cooling Equipment

The energy dilemma will undoubtedly affect the nature of future heating and cooling installations. The effect, however, will probably be in more efficient use of equipment rather than in drastic new designs for food service installations. The increasing difficulty of obtaining natural gas will result in some degree of shifting to electricity as a source for both heating and cooling equipment. Heat pumps, which have not received too much popularity in industrial application in the past, probably will become more popular in many new small to medium-sized installations. These heat pumps have the advantage of normally requiring less energy than resistance heating and also of affording some degree of cooling capability.

Traditionally, the prime purpose of food plant ventilation has been to help dry up moisture in the room and to afford some degree of comfort for the workers. However, with the current increasing cost of food and more emphasis being placed on quality in many installations, it probably will become more important for meat cutting rooms and food preparation areas to have better environmental control in order to preserve food quality. It has been estimated that supermarkets, for instance, could extend the shelf life of their cut and packaged meat considerably by using better environmental control in the cutting room. Obviously, this environmental control is expensive but with the increase in cost of food it may become justifiable in the future.

The biggest energy savings in heat and cooling systems must come from heat conservation and heat recovery. Typically, outside air is used for ventilation, odor removal, and humidity removal. The time is approaching when the use of this outside air is becoming prohibitive from the standpoint of the energy requirements. There is a trend to reduce the volume of this outside air and to rely on filtration, odor removal chemicals, and dehumidifiers to maintain the environmental conditions within the area. More and more work is being done with heat recovery systems to recover the energy normally discharged to the atmosphere from air exhaust systems. This approach is expensive, and manufacturers and food service establishments in general are not going to pay this capital expense unless energy becomes prohibitively costly or not available. Nevertheless, this trend is a very definite possibility in the next few years.

Heat recovery systems for recovering heat and humidity from the air being exhausted from a building and putting this recovered energy into the air being taken into the building is another concept which is becoming increasingly popular throughout the food service industry. This type of approach is equivalent to wheel-type exchangers, which have frequently been used. In addition to more efficient energy utilization, such a system has bacterial removal capabilities which are obviously of great benefit in food service applications.

One that is already receiving considerable emphasis is the so called make-up air systems. These make-up systems provide the amount of increased air which must be added to the recycled air from existing ventilation systems. If make-up systems are not included, there is no way to replace air which is lost during decontamination, and a lower air pressure inside of a building results. Consequently, outside air will try to get in through any available opening. Under pressure it comes in through windows, door cracks, and other openings creating uncomfortable and unhealthy drafts, picking up dust and debris, lowering temperatures in the building, and possibly constituting a hazard to both worker and customers. Make-up air, on the other hand, is introduced by a direct compensating system to replace air which has been exhausted. This make-up air may even be filtered prior to its addition to the room. It is anticipated that make-up systems will continue to find increasing importance in both customer areas and preparation areas in food service establishments. Obviously, the degree of make-up air required depends on the amount of recycling currently being done and one the temperature differentials between outside air and service air areas.

The possiblity of utilizing sun and sky radiation for heating and cooling of buildings has been discussed for many years. There are three technological processes by which solar energy can be utilized. These are (1) heliochemical, (2) helioelectrical, and (3) heliothermal. The first process through photosynthesis maintains life on this planet. The second process using photovoltaic converters provides power for all the communication satellites and will ultimately be very valuable for terrestrial applications. The third process is the one that can be used to provide much of the thermal energy needed for space heating and cooling and domestic hot water heating in areas such as food service establishements. While the idea of utilizing solar radiation for supplemental heating systems may become popular, current technology will not permit a major use of solar energy in food service establishments in the next ten to fifteen years. On a much longer time scale, however, it is quite conceivable that solar energy may be used to provide at least supplemental heating and cooling.

In summary, the major changes in heating and cooling equipment in the next fifteen years in the food service industry will probably be in the use of supplemental recycling and make-up air systems. Much more emphasis will be placed upon reusing as much air as possible. Greater filtration systems will also become quite prevalent.

Food Preparation Equipment

The recent energy crisis has resulted in a substantial reconsideration of the type of equipment that is most suitable for food preparation operations. While natural gas has traditionally been the choice of most professional chefs, it is becoming exceedingly more difficult in many locations of this country to obtain a supply of natural gas. Bottled gas like butane or propane works to some degree in the same manner as natural gas sources. But the cost of this bottled gas is becoming more significant in the efficiency of food service operations. It is anticipated that a trend away from gas-fired cooking equipment may become noticeable over the next few years. But traditional professional chefs will continue to use gas equipment as long as they can obtain it.

An examination of recent changes in food preparation equipment indicates that microwave ovens are probably not going to be overwhelmingle accepted by the food service industry. Microwave heating definitely has the potential for raising temperature on the interior of the food more evenly. But when a brown surface crust is required, microwave heating must be combined with some additional method. Microwave units do not have the type of capability desired by most professional chefs. Instead, they will be used as a means of warming precooked food in some establishments and as a secondary food preparation device in other operations. They should also be used to a greater extent in thawing foods.

Convection heating ovens continue to provide a very realistic method of preparation. These units are becoming larger and faster to operate, but the basic design remains unchanged and will probably continue to be unchanged in the next few years. For cooking large quantities, the steamer and steamjacketed kettle will continue to be used. Each provides a great deal of versatility plus savings in operating costs, labor, and food value. The cost of providing the steam supply may, however, become a significant factor.

In summary, one of the most important trends in food preparation equipment in the next ten to fifteen years should be an increasing awareness to the necessity for good kitchen procedures and maintenance attention. Many cooking units must be maintained more efficienty than they have been in the past to make better use of consumed energy. Considerable attention must also be given to the reuse of fats and oils in deep fat fryers. Many pieces of equipment are now available which considerably extend the use of these materials. In brief, however, no major technological changes are anticipated in the next few years.

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# A DYNAMIC MODEL
# OF CONSUMER DEMAND
# FOR AWAY-FROM-HOME FOOD

BY

James D. Smith, Ph. D.
and
Mark C. Schechter, M. A.

# A DYNAMIC MODEL
# OF CONSUMER DEMAND
# FOR AWAY-FROM-HOME FOOD

The work reported here represents a dynamic model of consumer demand for away-from-home food. The model relies heavily on Bureau of Labor Statistics (BLS) projections of economic growth and upon estimates of the parameters of an equation of consumer demand for away from home food fitted by Houthakker and Taylor.[1]

It is the function of the model to project the future value of food consumed away from home and, more importantly, the manpower needs of the food service industry.

Estimates of the number of establishments, purchases, and sales in segments of the food service industry have been made for 1971 by Knapp under contract to the National Restaurant Association, and published by that organization in its NRA Washington Report (May 19, 1973). The published report does not contain an adequate explanation of how the estimates were made, and Knapp has demurred to a request for information on his procedures. A careful examination of the sources he cites and of the internal structure and magnitude of his estimates, however, appears to support the essential reasonableness of the published finding.

## The Knapp Estimates

Although the Knapp estimates relate primarily to industry outputs, rather than the demands for labor inputs, with which the Futures project is concerned, inputs and outputs are obviously tightly related. It is well then, briefly to review his findings and procedures, to the extent that we can deduce them.

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[1] W. S. Houthakker and Lester D. Tayor, Consumer Demand in the United States, 1929-1970, Harvard University Press.

The Knapp estimates are divided into three broad areas, of which the first two are responsible for the overwhelming share of total activity. (See Table 1 below)

Table 1. Estimates Of Food and Drink Sales For 1971

| Industry Segment | Sales in billions |
|---|---|
| Commercial Feeding | $36.6 |
| Restaurants, lunchrooms, caterers | 16.2 |
| Commercial cafeterias | 2.1 |
| Refreshment places | 5.4 |
| Bars and taverns | 5.2 |
| Food contractors | 2.7 |
| Hotel restaurants | 1.4 |
| Motor hotel restaurants | 0.3 |
| Motel restaurants | 0.4 |
| Drug and proprietary store restaurants | 0.5 |
| General merchandise store restaurants | a |
| Department store restaurants | 0.5 |
| Variety store restaurants | 0.5 |
| Grocery store restaurants | 0.2 |
| Vending and nonstore retailers | 0.6 |
| Other commercial feed establishments | 0.6 |
| Commercial, Educational, Government, and Institutions running own food services | $7.7 |
| Other Government Feeding of Employees | $0.4 |
| All Places | $44.7 |

a--rounds to less than .1 billion dollars.

Source: NRA Washington Report, May 14, 1973

Over 80 percent of the food service industry is the private, or what Knapp calls the "commercial" segment of the industry. And within that segment, traditional eating and drinking places account for an overwhelming share of total sales. Even with increases in the market share going to vending operations and refreshment places, restaurants, lunchrooms, cafeterias and drinking places dominate the away-from-home food market.

Knapp's basic sources of information for most segments of the industry are The 1967 Census of Business, The 1963 Census of Business, and Current Retail Trade Reports, all produced by the United States Bureau of the Census. A number of adjustments were required to move the 1967 data forward to 1971, even for the segments for which the Census published direct estimates. Sometimes it was necessary for Knapp to allocate sales between two or more segments where the Census had published aggregated values for combined sectors. At times he was able to utilize external indicators, like industry reports, of the relative importance of one vis-a-vis other sectors in aggregated totals. At other times, he apparently made judgments based on his knowledge of the industry. It will be found in Appendix A that, for the most part, his results are consistent with what would have been the case had he taken the percentage contribution of each segment to total sales in 1967 and applied them to some estimated larger total sales figure for 1971, estimated from national income data. As has already been noted, one cannot know what he in fact did, but none of his 1971 estimates on the surface appear to be implausible, and as a matter of fact, they are quite consistent with the results obtained in this study.

## The Futures Estimates

To estimate the future need for food service workers, it is necessary to project forward the behavior that directly affects the demand for these workers. It is well known, for instance, that high income families spend more for food away from home than lower income families; this evidence was presented in the report of this Project's findings last year. However, that relationship is contingent not on the absolute level of family income, but is rather a statistical relationship between the amount of income spent for food and the total income of a family at varying points along the distribution of family incomes. It does not say, for instance, if all families enjoyed a ten percent increase in real purchasing power (while each family maintained its relative position in the distribution of family incomes) that food consumption would increase. It is now put forward, however, that the latter would also be the case--that away-from-home food consumption would also increase per capita if per capita real income increased while the relative distribution remained unchanged. In the context fo the United States economy, there are a number of reasons why this is the case. First, there has been a long-run growth in the labor force, which is not due merely to the growth of total population, but also to increasing labor force participation among women. When women produce goods outside of the home they are more likely to purchase meals away from home, just as was the case as working males shifted from production on the farms to factories and mills in metropolitan areas.

Secondly, a growing proportion of the labor force is accounted for by white collar workers. Male or female, white collar employees have a work ambience more suited to eating in restaurants and other commercial establishments than blue collar workers. This is due to the scheduling of work to include longer periods for eating, the portability of some employee's work to the dining room--salesmen, administrators, lawyers--and the greater proximity of commercial dining places to white collar work areas.

Thirdly, in the jargon of the economist, part of away-from-home eating is a "superior good" with an income elasticity greater than one. That is to say, when the collective income of all families goes up by one percent the collective consumption of certain types of away-from-home food goes up more than one percent. The types of away-from-home food which are relevant are those types associated with eating out "for the pleasure of it." Perhaps "dining" conveys the idea. The number of families and the frequency with which they go out to dine has increased as the income of the nation's families has grown.

In addition, the growth of the fast food industry has increased the purchasing power of dollars spent for less elegant eating out, indeed, for what might be called "inelegant" eating out. However one characterizes it, the fast food industry, by streamlining the production process of meal preparation and eliminating large amounts of the labor service component of the traditional restaurant as well as some of its non-kitchen capital per unit sales, has driven down the effective cost of limited selection meals. Fast foods have become particularly attractive to younger and less affluent members of the population.

In the Futures model we borrowed an equation of demand from Houthakker and Taylor (Consumer Demand in the United States), the leading investigators of U. S. consumer behavior. The equation is presented in Appendix B, but it essentially describes the relationship between the value of food eaten away from home in a given year and (a) food eaten away from home in the preceding year, (b) the value of all other consumption expenditures in the preceding year, (c) a price index of away-from-home food, and (d) the change in a price index of away-from-home food from the previous year to the current year.

The Bureau of Labor Statistics has a model of the U. S. economy which includes, among hundreds of others, an equation very similar to that described above. The BLS uses its model to project the characteristics of the labor force forward in time. The food equation is used to help estimate the number of a variety of occupations in the food service industry. For the BLS model to run, one must make judgments about the rate of growth in the economy, the stability of prices, birth rates, death rates, productivity, and a host of similar things. These judgments take the form of quantitative parameters, but they are judgments because no one knows how to predict the real underlying causes of changes in the rate of growth or prices. Ex post it is often easy enough to explain a phenomenon which one had virtually no chance of predicting. Economists can thread their way through the maze of the marketplace to trace out the final effect of the increase price of OPEC oil, but neither economist, nor political scientist, nor soothsayer of any genre could have predicted when the OPEC cartel would emerge.

In what we have called the "standard world", the BLS model is run with the assumption that growth in personal consumption expenditures will average about 4.6 percent from 1972 to 1980 and then slow down to about 3.3 percent to 1990. In the normal world, the numbers of workers in the food service industry were estimated by the BLS model for the years 1972, 1985 and 1990, and the simulating capacity of the Futures model was used only to interpolate the trajectory of the numbers of workers through the three BLS estimates.

In worlds other than the normal one, the assumptions of national rates of growth and productivity and price levels were altered to simulate what would be the case if incomes grew faster, prices over all or prices in the food industry grew more rapidly, or productivity increased at a faster pace. By altering one of these parameters and simulating the year to year consumption in food away from home (measured in real dollars) we developed a basis for estimating the need for food service workers with assumptions differing from those built into the BLS model. Essentially, the basis for the estimates of workers derives from the ratio of the estimated number of workers by type of worker to the value (real dollars) of away-from-home food in the normal world. That is, to take a specific case, we had from the normal world estimates of the number of dishwashers per dollar of food consumed away from home. If then we simulated a world in which food consumed away from home increased (relative to the normal world), but there were no simultaneous changes in the productivity of dishwashers, the estimated number of dishwashers needed in a future year was the product of the ratio of dishwashers to food away from home in the normal world times the higher level of away-from-home food in the simulated world.

We have described here in a simplified form the rather complex set of calculations and interactions between the BLS labor force model and our own Futures simulation model. The Appendices describe the Futures model and provide citations to the standard references for the BLS model.

By coupling our own model to the BLS model we have been able to take advantage of work done to estimate hundreds of equations at costs well over a million dollars without being restricted to the assumptions used to drive the BLS model.

# Appendix A

## Projections of Food Sales

The National Restaurant Association commissioned and published estimates of the sales of various segments of the food service industry for the year 1971. The work was done by Malcom Knapp, Inc., a profit research firm located in New York City. The firm will not supply adequate information about the methods it used to produce the estimates so there is no direct basis for assessing the quality of its results. But it has identified the basic sources of its statistical information. We have consulted those sources listed by NRA as a basis for the Knapp estimates and have worked through the data to determine the reasonableness of the results.

While Knapp's estimates are for 1971, he had to rely on detailed data for 1967 for most of the segments he estimated. In Table A-1 Knapp's sales estimates for 1971 establishments in the commercial sector are shown along side government estimates for 1967. It is presumably the government figures for 1967 with which Knapp started. When Knapp's figures for establishments are taken as percentages of the total and compared to comparable percentages for the government estimates for 1967 (columns 3 and 4) it is apparent that the two distributions are basically the same, only the levels have increased. Knapp shows estimates of food sales for drive-in movies, bowling alleys, and mobile caterers. These categories were not available in Census data and were estimated by Knapp using trade sources and a knowledge of the field. They account for only slightly over one percent of the total sales he estimates for 1971 so no effort was made to validate their precision.

In Table A-2 we show the Knapp estimates for 1971 and a set of estimates we have produced, also for 1971, using published government data and adjustments which we believe to be essentially those used by Knapp. It will be seen there that the differences between the two estimates are very small in relationship to the estimated magnitudes. We do not argue here that our estimates are correct and Knapp's incorrect. Indeed, we would suggest that there is no significant difference among them, given sampling and measurement errors in the original data from which they are derived. The one advantage that is associated with our numbers is that they are replicable by following our stated procedures, whereas, Knapp's procedures are proprietary and cannot be applied to new basic data by other researchers.

The set of adjustments which allow one to start with the retail trade data published for 1971 by the Census for establishments with and without payrolls and arrive at the sales of establishments with payrolls (those estimated by Knapp) is shown in detail in Tables A-3 through A-20.

## Table A-1

## FOOD AND DRINK SALES OF ESTABLISHMENTS WITH PAYROLL BY TYPE OF ESTABLISHMENT

| | Amounts In Thousands | | Percent | |
|---|---|---|---|---|
| Type of Establishment | Knapp--1971 | Government--1967 | Knapp--1971 | Government--1967 |
| Restaurants, Lunchrooms, and Caterers | $16,233,114 | $ 13,078,404 | 47.96 | 50.94 |
| Commercial Cafeterias | 2,135,682 | 1,459,452 | 6.31 | 5.68 |
| Refreshment Places | 5,425,660 | 3,417,643 | 16.03 | 13.31 |
| Bars and Taverns | 5,200,926 | 4,263,048 | 15.36 | 16.60 |
| Hotels | 1,404,887 | 1,105,312 | 4.15 | 4.30 |
| Motor Hotels | 317,390 | 314,000 | .94 | 1.22 |
| Motels | 236,988 | 300,000 | .70 | 1.17 |
| General Merchandise Stores | 29,504 | 17,919 | .09 | .07 |
| Department Stores | 469,394 | 320,578 | 1.39 | 1.25 |
| Variety Stores | 484,503 | 302,576 | 1.45 | 1.18 |
| Grocery Stores | 194,514 | 84,229 | .57 | .33 |
| Candy, Nut, Confectionery Stores | 24,040 | 11,633 | .07 | .05 |
| Dairy Product Stores | 39,240 | 26,941 | .12 | .10 |
| Bakery Product Stores | 40,898 | 31,439 | .12 | .12 |
| Drug and Proprietary Stores | 438,216 | 334,579 | 1.29 | 1.30 |

## Table A-1 (continued)

## FOOD AND DRINK SALES OF ESTABLISHMENTS WITH PAYROLL BY TYPE OF ESTABLISHMENT

| | | | | |
|---|---|---|---|---|
| Gasoline Service Stations | 107,817 | 80,549 | .32 | .31 |
| Other Retailers (Liquor, Cigar, etc.) | 68,896 | 53,962 | .20 | .21 |
| Vending and Non-store Retailers | 632,354 | 473,390 | 1.87 | 1.84 |
| Drive-in Movies | 64,504 | N.A. | .19 | N.A. |
| Bowling Lanes | 200,644 | N.A. | .59 | N.A. |
| Mobile Caterers | 101,200 | N.A. | .30 | N.A. |
| Totals | $2,895,724 | $ 1,737,795 | 100.00 | 100.00 |

Amounts may not add to totals due to rounding.

Source: Government, 1967 Census of Business, Retail Trade, Selected Services, United States Summary

Knapp, "The Food Service Industry 1971," NRA Washington Report, Vol. 16, No. 20, (May 14, 1973).

Government 1967 percentages are based on the total data available, data not available is ignored.

Food and drink sales in Dairy Product Stores is obtained by subtracting food and drink sales for all other types of Food Stores from total sales of food and drink in Food Stores.

N. A.--figures not available in the 1967 Census of Business.

## Table A-2

## FOOD AND DRINK SALES OF ESTABLISHMENTS WITH PAYROLL BY TYPE OF ESTABLISHMENT

| Type of Establishment | AMOUNTS IN MILLIONS Knapp 1971 Estimates | 1971 Estimates based on Government Data | Difference Knapp-Government |
|---|---|---|---|
| Restaurants, Lunchrooms, and Caterers | $ 16,233 | $ 16,276 | $ -43 |
| Commercial Cafeterias | 2,136 | 1,833 | 303 |
| Refreshment Places | 5,426 | 5,173 | 253 |
| Bars and Taverns | 5,201 | 5,697 | -496 |
| Hotels | 1,405 | 1,388 | 17 |
| Motor Hotels | 317 | 350 | -33 |
| Motels | 237 | 334 | -97 |
| General Merchandise Stores | 30 | 34 | -4 |
| Department Stores | 469 | 431 | 38 |
| Variety Stores | 485 | 393 | 92 |
| Grocery Stores | 195 | 110 | 85 |
| Candy, Nut, Confectionary | 24 | 16 | 8 |
| Dairy Product Stores | 39 | 36 | 3 |
| Bakery Product Stores | 41 | 31 | 10 |
| Drug and Proprietary Stores | 438 | 444 | -6 |
| Gasoline Service Stations | 108 | 106 | 2 |

Table A-2 (continued)

## FOOD AND DRINK SALES OF ESTABLISHMENTS WITH PAYROLL BY TYPE OF ESTABLISHMENT

| | | | |
|---|---|---|---|
| Other Retailers | 69 | 64 | 5 |
| Vending and Non-store Retailers | 632 | 634 | -2 |
| Drive-in Movies | 65 | N.A. | N.A. |
| Bowling Lanes | 201 | N.A. | N.A. |
| Mobile Caterers | 101 | N.A. | N.A. |
| Totals | $ 33,484 | $ 33,350 | $ 134 |

Amounts may not add to totals due to rounding.

Food and drink sales originating in drive-in movies, bowling lanes, and mobile caterers are not part of totals due to incomplete information.

N.A.--not available.

## TABLE A-3

## FOOD AND DRINK SALES ORIGINATING IN RESTAURANTS, LUNCHROOMS, AND CATERERS

| | |
|---|---|
| Government--1967 | $13,078,404,000 |
| Knapp--1971 | 16,233,114,000 |
| Estimated--1971 | 16,276,000,000 |

---

| | | (000,000 omitted) |
|---|---|---|
| 1. | Total sales of all Restaurants, Lunchrooms, Cafeterias, and Caterers for 1971, from the *Annual Retail Trade Summary, 1972*, p. 1. | $ 19,062 |
| 2. | Less 10.12%, which represents total 1967 Cafeteria Sales divided by the total sales of restaurants, lunchrooms, cafeterias, and caterers, from the *1967 Census of Business, United States Summary - Retail Trade*, p. 1-4. | - 1,929 |
| 3. | All retail sales of all restaurants, lunchrooms, and caterers (line 1 minus line 2). | 17,133 |
| 4. | All retail sales of all restaurants, lunchrooms, and caterers times 95%, which is the 1967 percentage of sales derived from eating places with payrolls; total sales of eating establishments with payrolls divided by the total sales of all eating establishments, source the *1967 Census of Business, United States Summary - Retail Trade*, p. 1-4. | |
| | Retail sales of restaurants, lunchrooms, and caterers with payroll. | $ 16,276 |

## TABLE A-4

## FOOD AND DRINK SALES ORIGINATING IN COMMERCIAL CAFETERIAS

| | |
|---|---|
| Government--1967 | $1,459,452,000 |
| Knapp--1971 | 2,135,682,000 |
| Estimated--1971 | 1,833,000,000 |

---

| | | (000,000 omitted) |
|---|---|---|
| 1. | Total sales of all Restaurants, Lunchrooms, Cafeterias, and Caterers for 1971 from the *Annual Retail Trade Summary*, 1972, p. 1. | $ 19,062 |
| 2. | Less 89.88%, which represents total 1967 restaurant, lunchroom, and caterer sales divided by the total sales of restaurants, lunchrooms, cafeterias, and caterers, from the *1967 Census of Business, United States Summary - Retail Trade*. | - 17,133 |
| 3. | All retail sales of all Cafeterias, (line 1 minus line 2). | 1,929 |
| 4. | All retail sales of all cafeterias times 95%, which is the 1967 percentage of sales derived from eating places with payrolls; total sales of eating establishments with payroll divided by the total sales of all eating establishments, source the *1967 Census of Business, United States Summary - Retail Trade*. | |
| | Retail sales of cafeterias with payroll | $ 1,833 |

## TABLE A-5

## FOOD AND DRINK SALES ORIGINATING IN REFRESHMENT PLACES

| | |
|---|---|
| Government--1967 | $ 3,417,643,000 |
| Knapp--1971 | 5,425,660,000 |
| Estimated--1971 | 5,173,000,000 |

---

| | | (000,000 omitted) |
|---|---|---|
| 1. | Total retail sales of all Eating Places for 1971, from the *Annual Retail Trade Summary, 1972*, p. 1. | $ 24,507 |
| 2. | Less 1971 sales of restaurants, lunchrooms, cafeterias, and caterers, from the *Annual Retail Trade Summary, 1972*, p. 1. | - 19,062 |
| 3. | Total retail sales of all refreshment places (line 1 minus line 2). | 5,445 |
| 4. | All retail sales of all refreshment places times 95%, which is the 1967 percentage of sales derived from eating places with payrolls; total sales of eating places with payroll divided by the total sales of all eating places, source, the *1967 Census of Business, United States Summary - Retail Trade*, p. 1-7. | |
| 5. | Retail sales of refreshment places with payroll. | $ 5,173 |

## TABLE A-6

## FOOD AND DRINK SALES ORIGINATING IN BARS AND TAVERNS

| | |
|---|---|
| Government--1967 | $ 4,263,048,000 |
| Knapp--1971 | 5,200,926,000 |
| Estimated--1971 | 5,697,000,000 |

---

| | (000,000 omitted) |
|---|---|
| 1. Total retail sales of all Drinking Establishments for 1971 from the *Annual Retail Trade Summary, 1972*, p. 1. | $ 6,624 |
| 2. All retail sales of all drinking places times 86%, which is the 1967 percentage of sales derived from drinking places with payrolls; total sales of drinking places with payroll divided by the total sales of all drinking places, source, the *1967 Census of Business, United States Summary - Retail Trade*. | |
| Retail sales of drinking places with payroll. | $ 5,697 |

## TABLE A-7

## FOOD AND DRINK SALES ORIGINATING IN HOTELS

| | |
|---|---|
| Government--1967 | $ 1,105,312,000 |
| Knapp--1971 | 1,404,887,000 |
| Estimated--1971 | 1,388,000,000 |

---

| | (000,000 omitted) |
|---|---|
| 1. Total of all lodging receipts for 1971, from the *Annual Selected Service Summary 1972*, p. | $ 7,856 |
| 2. Times 46.13%, total receipts of hotels in 1967 originating in 25 or more guest rooms--operating year round (10 months or more) with payroll divided by total 1967 receipts of loding places, source, *1967 Census of Business, Selected Services, United States Summary*, p. | 3,624 |
| 3. Times 38.3%, percentage of 1967 sales from food and drink of 25 or more guest rooms--year room hotels; origin *1967 Census of Business Selected Services--Hotels, Motor Hotels and Motels*, p. viii. | |
| Food and drink sales originating in hotels with payroll. | $ 1,388 |

## TABLE A-8

## FOOD AND DRINK SALES ORIGINATING IN MOTOR HOTELS

| | |
|---|---|
| Government--1967 | $ 314,000,000 |
| Knapp--1971 | 317,390,000 |
| Estimated--1971 | 350,000,000 |

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| | (000,000 omitted) |
|---|---|
| 1. Total of all lodging receipts for 1971, from the *Annual Selected Service Summary, 1972*, p. 1. | $ 7,856 |
| 2. Times 14.45%, total receipts from 1967 motor hotels with payroll divided by total 1967 receipts of loding places giving total receipts originating in motor hotels with payroll, source, *1967 Census of Business, Selected Services, United States Summary*, p. 1-8. | 1,135 |
| 3. Times 30.8%, percentage of 1967 sales from food and drink originating in motor hotels with payroll; origin, *1967 Census of Business Selected Services--Hotel, Motor Hotels and Motels*, p. viii. | |
| Food and drink sales originating in motor hotels with payroll. | $ 350 |

## TABLE A-9

## FOOD AND DRINK SALES ORIGINATING IN MOTELS

| | |
|---|---|
| Government--1967 | $ 300,000,000 |
| Knapp--1971 | 236,988,000 |
| Estimated--1971 | 334,000,000 |

---

| | (000,000 omitted) |
|---|---|
| 1. Total of all loding receipts for 1971, from the Annual Selected Service Summary, 1972, p. 1. | $ 7,856 |
| 2. Times 22.12%, total receipts from 1967 motels with payroll divided by total 1967 receipts of loding places giving total receipts originating in motels with payroll, source, 1967 Census of Business, Selected Services, United States Summary, p. 1-8. | 1,738 |
| 3. Times 19.2%, percentage of 1967 sales from food and drink originating in motels with payroll; origin, 1967 Census of Business Selected Services--Hotel, Motor Hotels and Motels, p. viii. | |
| Food and drink sales originating in motels with payroll. | $ 334 |

## TABLE A-10

## FOOD AND DRINK SALES ORIGINATING IN GENERAL MERCHANDISE STORES

| | |
|---|---|
| Government--1967 | $ 17,919,000 |
| Knapp--1971 | 29,504,000 |
| Estimated--1971 | 34,000,000 |

---

| | (000,000 omitted) |
|---|---|
| 1. Total sales of department stores and dry goods, general merchandise stores for 1971, from the Annual Retail Trade Summary, 1972, p. 1. | $ 50,969 |
| 2. Less 1971 department store sales from the Annual Retail Trade Summary, 1972, p. 1. | - 42,027 |
| 3. 1971 total retail sales of general merchandise stores. | 8,942 |
| 4. Total sales of general merchandise stores times 94%, which is the 1967 percentage of sales derived from general merchandise stores with payroll divided by 1967 total general merchandise store sales, source, 1967 Census of Business, Retail Trade, United States Summary, p. 1-4. | 8,405 |
| 5. Retail sales of general merchandise stores with payroll times .4%, which is the 1967 percentage of sales derived from meals, snacks, and alcoholic beverages in general merchandise stores with payrolls; total sales of general merchandise stores with payroll in meals, snacks, and alcoholic beverages divided by total sales of general merchandise stores with payroll, source, 1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary, p. 1-4. | |
| Food and drink sales originating in general merchandise stores with payroll. | $ 34 |

## TABLE A-11

## FOOD AND DRINK SALES ORIGINATING IN DEPARTMENT STORES

| | |
|---|---|
| Government--1967 | $ 320,578,000 |
| Knapp--1971 | 469,394,000 |
| Estimated--1971 | 431,000,000 |

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| | | (000,000 omitted) |
|---|---|---|
| 1. | 1967 total general merchandise and non-store sales, source, 1967 Census of Business, Retail Trade, United Summary, p. 1-6. | $ 51,160 |
| 2. | 1967 department store sales as a percentage of line 1 [32,344 divided by 51,160] = 63.22%, 1967 Census of Business, Retail Trade, United States Summary, p. 1-6. | |
| 3. | 1971 total sales of general merchandise group with non-stores, source, Annual Retail Trade Summary, 1972, p. 1. | 68,138 |
| 4. | Times line 2 (63.22%). | 43,074 |
| 5. | All department stores have payrolls, therefore, total sales of department stores with payroll, source, 1967 Census of Business, Retail Trade, United States Summary, p. 1-6. | 43,074 |
| 6. | Times 1%, percentage of sales originating from food and drink in department stores in 1967; 1967 total sales of food and drink in department stores divided by total department store sales in 1967; source, 1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary, p. 1-4. | |
| | Food and drink sales originating in department stores. | $ 431 |

## TABLE A-12

## FOOD AND DRINK SALES ORIGINATING IN VARIETY STORES

| | |
|---|---|
| Government--1967 | $ 302,578,000 |
| Knapp--1971 | 469,394,000 |
| Estimated--1971 | 393,000,000 |

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| | | (000,000 omitted) |
|---|---|---|
| 1. | Total sales of variety stores in 1971, source, Annual Retail Trade Summary, 1972, p. 1. | $ 6,972 |
| 2. | Less 1%--variety store without payroll, (1967 total sales of variety stores with payroll divided by total sales of all variety stores in 1967) minus one, source 1967 Census of Business, Retail Trade, United States Summary, p. 1-6. | - 70 |
| 3. | Total sales of variety stores with payroll | 6,902 |
| 4. | Times 5.7%, percentage of sales originating from food and drink in variety stores in 1967; 1967 total sales of meals and snacks in variety stores divided by 1967 total sales of variety stores with payroll; source, 1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary, p. 1-4. | |
| | Food and drink sales originating in variety stores with payroll. | $ 393 |

## TABLE A-13

## FOOD AND DRINK SALES ORIGINATING IN GROCERY STORES

| | |
|---|---|
| Government--1967 | $ 84,229,000 |
| Knapp--1971 | 194,514,000 |
| Estimated--1971 | 110,000,000 |

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| | | (000,000 omitted) |
|---|---|---|
| 1. | Total sales of grocery stores in 1971, source, *Annual Retail Trade Summary, 1972*, p. 1. | $ 82,793 |
| 2. | Times 95%--grocery store sales originating in stores with payroll, 1967 sales of grocery stores with payroll divided by 1967 total sales of grocery stores; source, *1967 Census of Business Retail Trade, United States Summary*, p. 1-6. | 78,653 |
| 3. | Total sales of grocery stores with payroll | 78,653 |
| 4. | Times .14%, percentage of sales originating from meal and snack sales in grocery stores in 1967; 1967 total meal and snack sales in grocery stores with payroll sales; source, *1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary*, p. 1-5. | |
| | Food and drink sales originating in grocery stores with payroll. | $ 110 |

## TABLE A-14

## FOOD AND DRINK SALES ORIGINATING IN CANDY, NUT, AND CONFECTIONARY STORES

| | |
|---|---|
| Government--1967 | $ 11,633,000 |
| Knapp--1971 | 24,040,000 |
| Estimated--1971 | 16,000,000 |

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| | (000,000 omitted) |
|---|---|
| 1. Total 1971 sales of food group stores, source, *Annual Retail Trade Summary, 1972*, p. 1. | $ 89,239 |
| 2. Times .8%--total food group sales derived from candy, nut, and confectionary stores; 1967 total candy, nut, confectionary store sales divided by 1967 total food group sales; source, *1967 Census of Business, Retail Trade, United States Summary,* p. 1-4. | 714 |
| 3. Times 68%--1967 total sales of candy, nut, and confectionary stores with payroll divided by total 1967 candy, nut, and confectionary store sales; source, *1967 Census of Business, Retail Trade, United States Summary*, p. 1-4. | 486 |
| 4. Times 3.2%, percentage of sales originating from meals and snack sales in candy, nut, and confectionary stores in 1967; 1967 total meal and snack sales in candy, nut, and confectionary stores divided by total 1967 candy, nut, and confectionary stores sales for establishments with payroll; source, *1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary*, p. 1-5. | |
| Food and drink sales originating in candy, nut, and confectionary stores with payroll. | $ 16 |

## TABLE A-15

## FOOD AND DRINK SALES ORIGINATING IN DAIRY PRODUCTS STORES

| | |
|---|---|
| Government--1967 | $ 26,941,000 |
| Knapp--1971 | 39,240,000 |
| Estimated--1971 | 36,000,000 |

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| | | | (000,000 omitted) |
|---|---|---|---|
| 1. | Total 1971 sales of food group stores, source, Annual Retail Trade Summary, 1972, p. 1. | | $ 89,239 |
| 2. | Times 94%, total food group sales from establishments with payroll, 1967 total payroll food group store sales divided by 1967 total food group store sales; source, 1967 Census of Business, Retail Trade, United States Summary, p. 1-4. | | 83,885 |
| 3. | Times .9%, percentage of total with payroll food group sales originating in dairy product stores with payroll; 1967 Census of Business, Retail Trade, United States Summary, p. 1-4. | | 755 |
| 4. | 1967 total food group with payroll sales from food and drink. | (000 omitted)<br>160,004 | |
| 5. | Less food and drink sales (with payroll) from all but dairy product stores. | -133,063 | |
| 6. | Food and drink sales in dairy product stores with payroll | 26,941 | |
| 7. | Line 6 divided by total 1967 sales of dairy product stores with payroll--4.8%; source, 1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary, p. 1-5 and 1-6. | | |
| 8. | Times (line 7) 4.8%--percentage of sales in dairy product stores originating from the sale of food and drink. | | $ 36 |

## TABLE A-16

## FOOD AND DRINK SALES ORIGINATING IN BAKERY PRODUCT STORES

| | |
|---|---|
| Government--1967 | $ 31,439,000 |
| Knapp--1971 | 40,898,000 |
| Estimated--1971 | 31,000,000 |

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| | (000,000 omitted) |
|---|---|
| 1. Total 1971 bakery product store sales, source, *Annual Retail Trade Summary, 1972*, p. 1. | $ 1,317 |
| 2. Times 93%--percentage of sales originating in bakery product stores with payroll; 1967 with payroll bakery product store sales divided by 1967 total bakery product store sales; source, *1967 Census of Business, Retail Trade, United States Summary*, p. 1-4. | 1,225 |
| 3. Times 2.5%--percentage of sales in bakery product stores with payroll originating from the sale of food and drink; total food and drink sales in payroll bakery product stores (1967) divided by 1967 total sales of bakery product stores with payroll; source, *1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary*, p. 1-6. | |
| Food and drink sales originating in bakery product stores. | $ 31 |

## TABLE A-17

## FOOD AND DRINK SALES ORIGINATING IN DRUG AND PROPRIETARY STORES

| | |
|---|---|
| Government--1967 | $ 334,579,000 |
| Knapp--1971 | 438,216,000 |
| Estimated--1971 | 444,000,000 |

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| | (000,000 omitted) |
|---|---|
| 1. Total 1971 drug and proprietary store sales; source, Annual Retail Trade Summary, 1972, p. 1. | $ 13,736 |
| 2. Times 98%--percentage of drug and proprietary store sales originating in stores with payroll, 1967 sales of drug and proprietary stores with payroll divided by total 1967 drug and proprietary store sales; source, 1967 Census of Business, Retail Trade, United States Summary, p. 1-4. | 13,461 |
| 3. Times 3.3%--percentage of sales in drug and proprietary stores with payroll originating from the sale of food and drink; total 1967 food and drink sales in payroll drug and proprietary stores divided by total 1967 sales of drug and proprietary stores with payroll; source, 1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary, p. 1-12. | |
| Food and drink sales originating in drug and proprietary stores with payroll. | $ 444 |

## TABLE A-18

## FOOD AND DRINK SALES ORIGINATING IN GASOLINE SERVICE STATIONS

| | |
|---|---|
| Government--1967 | $ 80,549,000 |
| Knapp--1971 | 107,817,000 |
| Estimated--1971 | 106,000,000 |

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| | | (000,000 omitted) |
|---|---|---|
| 1. | Total sales in 1971 of gasoline service stations; source, Annual Retail Trade Summary, 1972, p. 1. | $ 29,163 |
| 2. | Times 91%--sales derived from gasoline service stations with payroll; 1967 sales of gasoline service stations with payroll divided by 1967 total gasoline service sales; source, 1967 Census of Business, Retail Trade, United States Summary, p. 1-4. | 26,538 |
| 3. | Times .4%--percentage of payroll gasoline service station sales originating from the sale of food and drink, 1967 total food and drink sales in payroll gasoline service station sales; source, 1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary, p. 1-8. | |
| | Food and drink sales originating in gasoline service stations with payroll. | $ 106 |

## TABLE A-19

## FOOD AND DRINK SALES ORIGINATING IN OTHER RETAIL STORES* (LIQUOR, CIGARS, ETC.)

| | |
|---|---|
| Government--1967 | $ 53,962,000 |
| Knapp--1971 | 68,896,000 |
| Estimated--1971 | 64,000,000 |

| | (000,000 omitted) |
|---|---|
| 1. Total 1971 sales of retail store sales *Annual Retail Trade Summary, 1972*, p. 1. | $ 408,850 |
| 2. Times 2.5%--percentage of other retailers sales, 1967 sales of miscellaneous retail stores divided by 1967 sales of all retail stores; source, *1967 Census of Business, Retail Trade, United States Summary*, p. 1-4. | 10,221 |
| 3. Times 90%--percentage of other retailers with payroll; 1967 sales of miscellaneous retail stores with payroll divided by total miscellaneous retail store sales; source, *1967 Census of Business, Retail Trade, United States Summary*, p. 1-4. | 9,199 |
| 4. Times .7%--percentage of payroll other retailers sales originating from food and drink, 1967 food and drink sales in miscellaneous retail stores with payroll divided by 1967 total miscellaneous retail store with payroll sales; source, *1967 Census of Business, Retail Trade by Merchandise Line Sales, United States Summary*, p. 1-12-1-15. | |
| Food and drink sales originating in other retail stores with payroll. | $ 64 |

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[*] Knapp refers to this grouping as Other Retail Stores, it is listed in the *1967 Census* under the heading Miscellaneous Retail Stores.

## TABLE A-20

## FOOD AND DRINK SALES ORIGINATING IN VENDING AND NON-STORE RETAILERS*

| | |
|---|---|
| Government--1967 | $ 473,390,000 |
| Knapp--1971 | 632,354,000 |
| Estimated--1971 | 634,000,000 |

| | | | (000,000 omitted) |
|---|---|---|---|
| 1. | 1971 total sales for general merchandise group with non-stores, *Annual Retail Trade Summary, 1972*, p. 1. | | $ 68,134 |
| 2. | 1967 non-stores as a percentage of general merchandise and non-stores | | |
| | General merchandise | $ 43,537 | |
| | + Non-store | 7,623 | |
| | Total | $ 51,160 | |
| | 1967 non-stores as a percentage of general merchandise and non-store sales [7,623 divided by 51,160] = 14.9%; source, *1967 Census of Business, Retail Trade, United States Summary*, p. 1-4. | | |
| 3. | 14.9%, line 2, times line 1.<br>1971 non-store retailer sales. | | 10,152 |
| 4. | Times 88%--percentage of non-store retailers with payroll; 1967 sales of non-store retailers with payroll divided by 1967 sales of all non-store retailers; source, *1967 Census of Business, Retail Trade, United States Summary*, p. 1-4. | | 8,934 |
| 5. | Times 7.1%--percentage of payroll non-store retailers sales originating from food and drink; 1967 food and drink sales in non-store retailers with payroll divided by 1967 total with payroll non-store sales; source, *1967 Census of Business Retail Trade by Merchandise Line Sales, United States Summary*, p. 1-15 - 1-16. | | |
| | Food and drink sales originating in non-store retailers with payroll. | | $ 634 |

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* The government classes vending or merchandising machine operators as part of non-store retailers rather than as a separate title.

# Appendix B

# The Futures Model

The Futures Model projects the numbers of food service workers demanded to the year 1985. Separate estimates of workers are made for the eating and drinking industry alone, and for all industries which employ food service workers taken as a group.

The model draws heavily on the Bureau of Labor Statistics' Employment Model, but includes statistical relationships between food consumption and other variables such as aggregate personal income and relative prices. As with all forecasting models, assumptions are made about some key parameters and the values of variables of central interest to the researcher are then estimated within the model. The key parameters which are set by assumption in the Futures Model are (1) the rate of increase in national personal consumption expenditures (4.6 percent per year from 1972 to 1980, and 3.3 percent per year from 1980 to 1985 in the "standard world"); and (2) the rate of price increase (1.3 percent in the "standard world"). By changing the assumed values of rates of growth of total consumption and prices, the behavior of the labor market can be simulated in more or less rapidly changing economic environments. The "standard world" refers to a set of trends which most economists would have accepted as best guesses of economic performance over the long pull. It ignores such exogenous factors as wars, famines, and new international oil cartels.

## Estimating Procedures

This section explains the methodology used to determine

1. food service labor needs from 1972 to 1985 under normal aggregate economic assumptions, and

2. food service labor needs from 1972 to 1985 under other than normal aggregate economic assumptions.

Labor needs to 1985 under normal economic assumptions were found by extrapolating between point estimates for 1970, 1980, and 1985.[1] Extrapolation was accomplished by adjusting the point estimates by a simple compounding rate of increase where the rate for each occupation between 1970 and 1980 is

$$1-10^{[(\text{Log}\,\frac{1980\ \text{occupation}}{1970\ \text{occupation}})\div 10]}$$

where 1980 occupation = 1980 point estimate for a particular occupation

1970 occupation = 1970 point estimate for a particular occupation

and the rate for each occupation between 1980 and 1985 is

$$1-10^{[(\text{Log}\,\frac{1985\ \text{occupation}}{1980\ \text{occupation}}\div 5]}\ ,$$

where 1985 occupation = 1985 point estimate for a particular occupation

1980 occupation = 1980 point estimate for a particular occupation.

To reflect more accurately the process of changing demand for food service workers, the results as previously presented were repeatedly smoothed using a five year moving average:

$$\text{occupation }(Y) = 5P[(\text{occupation}(Y-2) + \text{occupation }(Y-1) + \text{occupation }(Y) + \text{occupation }(Y+1) + \text{occupation}(Y+2)) \div 5]\ ;$$

where occupation = number of workers in a particular occupation

(Y) = year 1970 to 1985

P = number of times five year moving average is applied.

Because the level of demand for food service workers depends upon the amount of food consumed away from home, this quantity was estimated to 1985 (in 1972 dollars). Projections of the level of demand for food consumed away from home were facilitated by first projecting the quantity of food consumed at eating and drinking places from 1972 to 1985. These quantities were then adjusted to a total away-from-home food level on the basis of the proportion they represent of total away from home food. Finally, alcohol consumption in eating and drinking places was projected to 1985 as a proportion of total expenditures in eating and drinking places.

The per capita quantity of food consumed at eating and drinking places was estimated using the aggregate consumption function:[2]

$$QF'_t = 20.963 + .7159QF'_{t-1} + .621\Delta C_t + .0097C_{t-1} - 1.2311\Delta RP_t - .1922RP_{t-1}$$

$$QF_t = QF'_t \text{ X } I1972$$

where; $QF'_t$ = per capita personal consumption expenditure of food consumed at eating and drinking places in year t (1954 dollars).[3]

$C_{t-1}$ = total per capita personal consumption expenditure in year t-1 (1954 dollars).[4]

$\Delta C_t = C_t - C_{t-1}$

$RP_{t-1}$ = relative price in year t-1 of food consumed at eating and drinking places (1972 = 100)[5]

$I1972$ = 1954 based 1972 deflator

$QF_t$ = per capita personal consumption expenditures of food consumed at eating and drinking places in year t (1972 dollars).

Total food consumed at eating and drinking places was found by multiplying the per capita quantities by the total population.[6] To find total away-from-home food consumption, total food consumed at eating and drinking places was adjusted as follows:[7]

$$\text{Total away from home food consumption}_{(Y)} = \frac{1}{FE{+}D_{1970}/TAF_{1970}} \times FE{+}D_{(Y)}\ ;$$

where $FE{+}D_{1970}$ = total food consumed at eating and drinking places in 1970.

$TAF_{1970}$ = total food consumed away from home in 1970.

(Y) = year 1972 to 1985.

Alcohol consumption in eating and drinking places represent 24 percent of their total sales.[8] For the years to 1985, alcohol consumption in eating and drinking places was found as follows:

$$\text{Alcohol consumption in eating and drinking places}_{(Y)} = \left(\frac{1}{.24} \times FE{+}D_{(Y)}\right) - FE{+}D_{(Y)}\ ;$$

where FED+D = total food consumed at eating and drinking places.

(Y) = year 1972 to 1985.

Projections of the demand for food service workers to 1985 under other than normal assumptions about the aggregate economy were made using a two-step procedure. First, total away-from-home food consumption was altered to reflect different assumptions; then, numbers of food service workers were altered to reflect the number of workers needed to supply the altered level of away-from-home food consumption.

Total food consumed at eating and drinking places was altered by adjusting the values of the independent variables of the previously detailed aggregate consumption function. For example, by reducing the rate of real growth in personal consumption expenditures, the level of total food consumed at eating and drinking places will rise in each year due to the negative relationship between food consumption and relative prices. Total away-from-home food consumption and alcohol consumption in eating and drinking places were then determined by applying the previously described procedures to the altered values of food consumed at eating and drinking places.

The projected total numbers of food service workers (excluding bartenders) demanded by all industries was then found by dividing total food consumed away from home by the dollars of output per worker ratio, where the output per worker ratios were calculated as follows:

$$TOR_{(Y)} = TAFN_{(Y)} / OCCUPATION_{(Y)} \quad ;$$

where TOR = output per food service worker ratio for a particular occupation in all industries

TAFN = total food consumed away from home under normal economic assumptions

OCCUPATION = number of workers in a particular occuaption under normal economic assumptions

(Y) = year 1970 to 1985.

The projected total number of food service workers (excluding bartenders) demanded in eating and drinking places was found by dividing total food consumed at eating and drinking places by the dollars of output per worker ratio, where the output per worker ratios were calculated as follows:

$$E{=}DOR_{(Y)} = FE{+}DN_{(Y)} / OCCUPATION_{(Y)} \quad ;$$

where E+DOR = output per food service worker ratio for a particular occupation in eating and drinking places

FE+DN = total food consumed at eating and drinking places under normal economic assumptions

OCCUPATION = number of workers in a particular occupation (in eating and drinking places) under normal economic assumptions

(Y) = year 1970 to 1985.

Finally, total numbers of bartenders demanded in all industries and in eating and drinking places was found by dividing alcohol consumed at eating and drinking places by the dollars of output per bartender ratio, where the output per bartender ratios were calculated as follows:

$$BOR_{(Y)} = ALCOHOLN_{(Y)}/BARTENDERS_{(Y)} ;$$

where BOR = output per bartender ratio in eating and drinking places

ALCOHOLN = total alcohol consumption at eating and drinking places under normal economic assumptions

BARTENDERS = total number of bartenders (in all industries and in eating and drinking places) under normal economic assumptions

(Y) = year 1970 to 1985.

## References

1. Appendix E describes the Bureau of Labor Statistics Employment Model from which the point estimates originated.

   Also see: U.S. Dept. of Labor, B.L.S., "Tomorrow's Manpower Needs," Bulletin #1737, 1971, and, "Occupational Employment Statistics, Sources and Data," Report #305, 1966.

2. Houthakker, H.S. and Taylor, Lester D., Consumer Demand in the United States, 1929-1970 (Harvard University Press, Cambridge, Mass.,(1966), pg. 62.

3. $QF'_{t-1}$ is purchased meals taken from Statistical Abstracts of the United States 1972, pg. 315 minus alcoholic beverages taken from U. S. Dept. of Commerce, Bureau of Economic Analysis, Current Business Statistics, 1967, pg. 1-11.

4. $C_t$ from 1970 to 1985 was determined using rates of real growth in personal consumption expenditures found in U. S. Dept. of Labor, B.L.S., Bulletin #1807, pg. 33.

5. Relative prices are:

$$\frac{\text{Price deflator (1972=100) of food consumed at eating and drinking places}(t)}{\text{Price deflator (1972=100) of personal consumption expenditures }(t)}$$

6. Series D population projections were used. U.S. Dept. of Commerce, Bureau of the Census, Current Population Reports, Series P-25, #448, August 6, 1970.

7. Ratio of total food consumed at eating and drinking places to total food consumed away from home were in NRA Washington Report, Vol. 16, #20, May 14, 1973.

8. U. S. Dept. of Commerce, Bureau of Economic Analysis, Current Business Statistics 1967, pg. 1-11.

# Appendix C

## Projected Food Service Occupations Broken Down by Inclusive Job Titles

### I. Bakers

Baker
Batter mixer
Bench hand
Bread baker
Bread maker--own home
Cake decorator
Cake froster
Cake icer
Cake maker
Cake mixer
Chef
Cook
Decorator
Dough maker
Dough mixer
Doughman
French-pastry cook
Head cook
Head Mixer
Icer
Kneader
Mixer
Mixerman
Oven operator
Oven tender
Oven worker
Ovenman
Pastry baker
Pastry chef
Pastry cook
Pastry decorator
Pastry finisher
Pie baker
Pie baker--own home
Pie maker
Sponge maker
Sponge setter
Sponger

### II. Bartenders

Barkeeper
Bartender
Drink Mixer
Mixologist
Tavern-car attendant

### III. Busboys

Bar boy
Bus boy
Bus girl
Busboy--dishwasher,
clearing tables
Busser
Dumb-waiter operator
Hotel runner, food service
Iceman
Room-service boy, food service
Runner, Food order delivery
Service boy, food service
Set-up girl or boy, dining room tables
Water boy
Water carrier

### IV. Cooks, except private household

Barbecue cook
Broaster
Broiler chef or cook
Broiler man
Bull cook--restaurant
Cafeteria cook
Camp cook
Chef--any not listed above

## IV. Cooks, except private household (cont.)

- Chuck-wagon cook--Ranch
- Cold-meat man
- Combination girl
- Combination man
- Cook-mfg. cafeteria
- Cook--any not listed above
- Cook and waitress
- Diet-kitchen cook
- Fry cook
- Fryline attendant
- Galley cook
- Griddle man
- Grill cook
- Grill girl
- Grillman
- Head cook
- Kitchen chef
- Pastry chef
- Pastry cook
- Pie baker
- Pie maker
- Pizza maker--exc.
- Ranch cook
- Roundsman
- Salad chef
- School cook
- Second cook
- Ship's cook
- Short-order cook
- Special-diet cook
- Vegetable cook--exc.

## V. Dietitians

- Consultant, dietitian
- Diet supervisor
- Diet therapist
- Dietist
- Dietitian
- Food adviser
- Nutrition director
- Nutritionist
- Public-health dietitian
- Research dietitian
- Teacher
  - Dietary aides
  - Nutrition aides
- Therapeutic dietitian

## VI. Dishwashers

- Breakdown man, sorts items for dishwasher
- Busboy--dishwasher, dishwashing
- Dishwasher
- Dishwasher--machine operator
- Glass washer
- Pan cleaner
- Pan washer
- Pot boy
- Pot washer
- Silver cleaner
- Silverman
- Silverware cleaner

## VII. Food counter and fountain workers

- Assistant Cafeteria
- Attendant, counter
- Buffet girl
- Cafeteria attendant
- Cafeteria worker
- Coffee-bar attendant
- Coke girl
- Counter attendant
- Counter clerk, food service
- Counter clerk, N.S.
- Counter hop
- Counter waitress
- Dish-up girl--cafeteria
- Food server, cafeteria
- Fountain attendant
- Fountain boy
- Fountain clerk
- Fountain dispenser
- Fountain girl
- Fountain jerk
- Fountain waitress
- Helper
  - Counter
  - Fountain
- Manager
  - Dairy bar
  - Fountain
  - Lunch counter
  - Soda fountain
- Order filler
- Order taker
- Salad--counter girl

## VII. Food counter and fountain workers (cont.)

Soda clerk
Soda dispenser
Soda-fountain clerk
Soda-fountain operator
Soda jerker
Steam-table attendant
Steam-table worker
Waitress, counter
Window man
Window service

## VIII. Restaurant, cafeteria, and bar managers

Cafe operator
Cafeteria director
Cafeteria operator
Caterer
Concessionaire
Luncheonette operator
Lunchroom operator
Lunchroom supervisor
Manager
  Banquet
  Bartender-manager
  Cafeteria
  Canteen

Catering--hotel
Club
Cocktail lounge
Luncheonette
Lunchroom
Restaurant
School lunch
Tea room
N.S.
Official
Owner
Owner-bartender
Owner-manager
Owner-operator
Restauranteur--own
Saloonkeeper
Tavern keeper
Tavern operator

## IX. Waiters

Bar hostess
Bar waitress
Barmaid
Boat hop
Captain, dining room
Captain, N.S.
Car hop
Car hostess
Club boy
Club man
Cocktail waitress
Crew messman
Curb attendant
Curb boy
Curb girl
Curb hop
Curb-hop waiter
Curb hopper
Curber
Dining-car hop
Dining-room attendant
Dining-room boy
Dining-room captain
Dining-room girl
Dining-room hostess
Floor girl
Head waiter
Helper
  Dining room
Hostess
Mess attendant
Mess boy
Messman
Service captain, supervising waiter
Singing waiter
Tearoom hostess
Waiter--exc.
Waitress and cashier
Waitress, N.S. --exc.

## X. Food service workers, NEC except private households

Assistant
  Kitchen
  N.S.
Beverage man
Blockman
Cafe worker
Caterer's aide
Cleaner, kitchen

## X. Food service worker, NEC except private households (cont.)

Coffee girl
Coffee maker
Coffee man
Cookee
Culinary worker
Diet-kitchen worker
Diet maid
Dish stacker
Employee
Food aide
Food-cart boy
Food handler
Food runner
Food server, kitchen
Food-service supervisor
Food service worker
Galley boy
Handyman, kitchen help
Hasher
Helper
   Baker's
   Bartender's
   Cafe
   Cafeteria
      Cook's --any not listed above
      Dietitian's
   Kitchen--any not listed above
   N.s.
Hostess-vending machines
Kitchen boy
Kitchen girl
Kitchen maid
Kitchen man
Kitchen runner
Kitchen worker
Line runner-cafeteria
Location attendant--vending machine sales
Lunchroom attendant
Lunchroom worker
Pantry boy
Pantry girl
Pantry maid
Pantry man
Pantry worker
Parer
Peeler
Pie cutter
Raw-bar man
Salad girl
Salad maker
Salad woman
Sandwich girl
Sandwich maker
Sandwich man
Scullion
Teletray operator--drive-in-restaurant
Tray boy, food service
Tray girl, food service
Vegetable girl--exc.

# Appendix D

## Aggregate Economic Assumptions

### A. Normal Aggregate Economic Assumptions

| Real Growth in Personal Consumption Expenditures | | % Increase in Relative Price |
|---|---|---|
| 1972-1980 | 1980-1985 | 1972-1985 |
| 4.6% | 3.3% | 1.3% |

### B. Alterations to normal assumptions

| | % Over/Under Normal Real Growth in Personal Consumption Expenditures | | % Increase in Relative Prices |
|---|---|---|---|
| Alteration # | 1972-1980 | 1980-1985 | 1972-1985 |
| 1 | 10% | 10% | 1.3% |
| 2 | 20% | 20% | 1.3% |
| 3 | 0% | 0% | 2.5% |
| 4 | 0% | 0% | 5.0% |
| 5 | 0% | 0% | 10.0% |
| 6 | 0% | 0% | 0.0% |
| 7 | 0% | 0% | -2.5% |
| 8 | 0% | 0% | -5.0% |
| 9 | -10% | -10% | 1.3% |
| 10 | -10% | -10% | 2.5% |
| 11 | -10% | -10% | 5.0% |
| 12 | -10% | -10% | 10.0% |
| 13 | -20% | -20% | 1.3% |
| 14 | -20% | -20% | 2.5% |
| 15 | -20% | -20% | 5.0% |
| 16 | -20% | -20% | 10.0% |

# Appendix E

## The B.L.S. Employment Model

The Bureau of Labor Statistics employment model is based primarily on the disaggregation and distribution of projected real gross national product. The projection of real gross national product supplies to the model an aggregate demand figure, the basis on which output is distributed and occupational employment is determined.

First, the labor force must be determined for a target year where

Labor force = f(population size, age distribution, labor force participation rate, military employment).

Second, the labor force must be adjusted by the rate of unemployment where

Total employment = labor force - military employment - (unemployment rate X labor force).

Third, annual hours per worker must be determined where

Average annual hours per worker = f(trend avg., work week, percent part time employees).

Fourth, output per man hours must be determined for each of the three sectors: farm, nonfarm, and government.

By combining the projections of labor force, change in hours, and output per man hour, gross national product for a target year can be determined. The model for GNP projection is as follows:

$$GNP_B = E_B \times H_B \times O_B \; ;$$

where $GNP_B$ = GNP for a base year

$E_B$ = base year employment

$H_B$ = base year average annual hours per worker

$O_B$ = base year output per man hour ;

and

$$\text{Projected GNP} = \text{GNP}_B = [\ (E_B = \sum_{i=B+1}^{n} \Delta E_i)\ X\ (H_B + \sum_{i=B+1}^{n} \Delta H_i)\ X$$

$$(O_B + \sum_{i=B+1}^{n} \Delta O_i)]\ ;$$

where E = change in employment in year i

H = change in average annula hours per worker in year i

O = change in output per man hour in year i.

Projected GNP is them distributed among the major demand components; consumer, government, private domestic investment, and net foreign. The major demand components are further disaggregated into demands by industry. Through the use of an input-output system, projections of the demand of final users such as consumers can be translated into the total requirements from all industries as follows:

Given

Y, an x 1 vector of final demands

X, an x 1 vector of industry outputs

T, an x n matrix of intermediate input-output transactions in which the elements of a row or a column are additive.

In Particular

$$\sum_{j=1}^{n} T_{ij} + Y_i = X_i \text{ for all } i=1,\ldots\ldots,n$$

where i's represent rows and j's represent columns.

And Defining

$$\frac{T_{ij}}{X_j} = A_{ij},\ T_{ij} = A_{ij}X_j$$

where every $A_{ij}$ is one element in the direct coefficients matrix A.

Then

$$\sum_{j=1}^{n} A_{ij},\ S_j = \sum_{j=1}^{n} T_{ij}$$

*and* by substitution

$$\sum_{j=1}^{n} A_{ij} X_j + Y_i = X_i \text{ for each sector.}$$

*For* all sectors $AX + Y = X$

*so* that by rearranging and factoring

$$X - AX = Y, (1-A)X = Y$$

where I is an x n identity matrix.

Finally, derive the inverse of (I-A) and premultiply both sides of the last equation by the inverse matrix $(I-A)^{-1}$ so that

$$X = (I-A)^{-1}Y.$$

Industry employment is now determinable by equating the industry output, as found through the input-output system, with the level of employment necessary to produce that level of output with respect to output per man hour and annual hours per worker such that

Industry output = output per man hr. X annual hrs. per worker

Annual man hours = projected output/output per man hour

Employment = man hours/annual hours per worker

Future occupational requirements were projected using industry-occupational matrices dividing the total U. S. employment into 160 occupations cross classified by 116 industries. The industry-occupational matrices were made consistent with the industry employment projections of the input-output matrix approach by iterative forcing until internal matrix cells were consistent with both industry and occupational controls established by occupational studies.

# A STUDY OF
# GUESTS' PERCEPTIONS OF RESTAURANT SERVERS

by

Arthur Patterson, Ph.D.

# A STUDY OF
# GUESTS' PERCEPTIONS OF RESTAURANT SERVERS

## Introduction

To understand better the server's role in the dining event, it would be useful to understand better the server-guest relationship. An understanding of this relationship helps train servers to deal with the changes in a guest's perceptions of the dining event, and thus to facilitate the dining experience.

One method of approaching this problem is through investigating the guest's perceptions of the server, and the service received, during a dining experience. Of interest would be the effects of these perceptions of the server and service upon the guest's perceptions of the restaurant setting, and various aspects of the food, general dining experience, and future feelings about the restaurant (such as how soon the guest expects to return).

This study describes a survey designed to answer some of those questions. Guests at restaurants, which appeared to differ in the level of service provided (from formal to informal), were surveyed.

## The Method

### Respondents

The respondents were 104 diners who completed a questionnaire after dining at one of the three surveyed restaurants: "French Restaurant," "Truck Stop," and "Fast Food." (These are code names used to mask actual identity of the three Central Pennsylvania restaurants.) There were 48 respondents from the French Restaurant, 29 respondents from the Truck Stop, and 27 respondents from Fast Food.

### Instrument

Extensive pilot testing yielded a questionnaire with six subscales measuring various facets of food, service, and environment. All of the items employed the semantic differential-type format, which presented bipolar adjectives. The respondent chose the place along the continuum between the adjectives that corresponded to his attitude.

The questionnaire also contained items that ascertained the number of guests in the party, the respondent's frequency of dining at that restaurant, the respondent's frequency of dining out, and how soon the respondent expected to return to the restaurant.

The first subscale dealt with the restaurant environment. This subscale contained items that sought to discover whether the respondent thought that the restaurant was comfortable or uncomfortable, colorful or drab, inviting or uninviting, noisy or quiet, etc. The second subscale dealt with the respondent's perception of the food. This subscale measured such items as whether the food was flavorful or bland, appetizing or unappetizing, enjoyable or unenjoyable, etc. The third subscale dealt with the server. These items were concerned with whether the server was patient or impatient, attentive or inattentive, personal or impersonal, careless or careful, etc. The fourth subscale dealt with the service in general. The items were concerned with whether the service was fast or slow, efficient or inefficient, correct or incorrect, etc. The fifth subscale dealt with the meal in general. The items here questioned whether the meal was prepared correctly or incorrectly and was served correctly or incorrectly. The final subscale dealt with the overall dining experience, and contained items concerned with whether the experience was pleasant or unpleasant, satisfactory or unsatisfactory, and "good" or "bad." In the case of the Fast Food restaurant, where there was no server other than someone to distribute the food at the counter, the third subscale was omitted. A sample copy of the complete questionnaire is presented in the Appendix A.

Procedure

Three restaurants selected were all in the Central Pennsylvania area. They were chosen for the survey on the basis of their relative size (all accommodate approximately 100 guests), and also on the basis of their distribution along a continuum of service in restaurants. That is, the French Restaurant was relatively formal in service, having a *Maître d'* and a waiter; the Truck Stop was relatively informal, having counter service and waitresses; and the Fast Food establishment was informal having only counter pick-up with no waiters. The restaurants were visited during weekday evening dining hours, and the questionnaires were distributed to the guests at the close of the meal.

## Results

Because some respondents incorrectly completed or failed to complete the questionnaire, the final number of repondents was 91 (French Restaurant 41, Truck Stop 24, and Fast Food 26). The coefficient alpha index of reliability for the overall scale was = .917. For subscale 1 (restaurant environment) the reliability was .740; for subscale 2 (the food) the reliability was .813; for subscale 3 (the server) the reliability was .938; for subscale 4 (the service) the reliability was .680; for subscale 5 (the meal) the reliability was .685; and for subscale 6 (the dining experience) the reliability was .917.

Each item of a subscale was scored from 5 to 1, with a 5 being awarded for endorsing the positive adjective (e.g., comfortable), and a 1 being awarded for endorsing the negative adjective (e.g., uncomfortable). The intermediate points were scored 4 or 2 (depending on the direction), and the middle point was scored as 3. The score for each item on the subscale was added to yield a subscale total score for the individual. The mean score for each subscale for the three restaurants is presented in Table 1. Also presented are the standard deviations and the coefficient alpha indexes of reliability. As the mean for all three restaurants for the variable concerning the number of guests in the party was slightly over two, and since there was no statistical difference among them, this data was omitted from any further analysis. However, the results of the three remaining variables (frequency of dining at that restaurant, frequency of dining out, and expected return) are also presented in Table 1.

An univariate analysis of variance was computed for five of the subscales and the three remaining variables, comparing the three restaurants. Because subscale 3 applied to only two of the restaurants, a $t$ test was used for its analysis. For the first subscale (restaurant environment) there was a significant difference ($F = 6.31$, $df = 2,90$, $p < .005$). The environment of the Truck Stop was

Table 1. Scores for the Three Restaurants on the Questionnaire Items

| | (1) Restaurant Environment | (2) Food | (3) Server | (4) Service | (5) Meal | (6) Dining Experience | Frequency of Dining at that Restaurant | Frequency of Dining Out | How Soon Expecting to Return |
|---|---|---|---|---|---|---|---|---|---|
| **Fast Food** | | | | | | | | | |
| Mean | 33.58 | 19.50 | -- | 22.71 | 8.54 | 12.46 | 2.25 | 3.96 | 3.33 |
| Standard deviation | 4.25 | 3.86 | -- | 1.93 | 1.49 | 1.75 | 1.12 | 1.02 | .67 |
| Reliability | .62 | .88 | -- | .55 | .67 | .96 | -- | -- | -- |
| **French Restaurant** | | | | | | | | | |
| Mean | 34.68 | 22.37 | 56.14 | 22.46 | 9.17 | 14.10 | 3.05 | 3.80 | 4.10 |
| Standard deviation | 5.29 | 3.47 | 7.66 | 2.27 | 1.66 | 2.21 | 1.36 | .91 | .85 |
| Reliability | .79 | .83 | .88 | .65 | .68 | .98 | -- | -- | -- |
| **Truck Stop** | | | | | | | | | |
| Mean | 38.34 | 20.34 | 54.30 | 21.84 | 8.76 | 12.46 | 2.35 | 3.96 | 2.92 |
| Standard deviation | 4.98 | 3.56 | 8.73 | 3.95 | 1.55 | 2.89 | 1.20 | 1.16 | 1.17 |
| Reliability | .70 | .70 | .92 | .85 | .60 | .86 | -- | -- | -- |

most favorably evaluated, followed in order by the French Restaurant and Fast Food. (The means for this and the following analyses are presented in Table 1.) For the second subscale (food) there was a significant difference ($F = 5.66$, df = 2,90, $p < .005$). The food at the French Restaurant was evaluated most favorably, followed in order by the Truck Stop and Fast Food. For the third subscale (the server) a *t* test yielded no significant difference between the servers at the French Restaurant and the Truck Stop ($+ = .915$, df = 65, n.s.).

The analysis of variance for the fourth subscale (service) and the fifth subscale (the meal) also yield no significant differences ($F = .641$, df = 2,90, $p < .50$; $F = 1.480$, df = 2,90, $p < .25$) among the restaurants. However, the analysis of the sixth subscale (dining experience) provided a significant difference ($F = 5.921$, df = 2,90, $p < .005$). The dining experience at the French Restaurant was viewed more positively than the experience at either the Truck Stop or the Fast Food, and there was no significant difference between the experiences at the latter two.

The analysis of the measure of frequency of dining at the restaurant yielded a significant difference ($F = 4.282$, df = 2,90, $p$ .01). Respondents who dined at the French Restaurant ate there more often than the respondents who dined at the Truck Stop or Fast Food dined at their restaurants. There was no significant difference between the Truck Stop and Fast Food on this variable. For the variable of how frequently the respondents dined out, there was no significant difference among respondents at the different restaurants ($F = .178$, $df = 2,90$, $p < .05$). Diners at the French Restaurant expected to return sooner than did diners at other the Truck Stop or Fast Food. Also, diners at the Truck Stop expected to return sooner than did diners at Fast Food.

Pearson product-moment correlations were computed among all the subscales and the remaining three variables for the entire sample. (These are presented in Table 2.) These correlations indicate the degree of linear relationship between variables. For 91 degrees of freedom, a correlation of only .195 is necessary to achieve statistical significance. However, this is a relatively small magnitude correlation. If one squares a correlation ($r^2$), the resultant figure is the amount of variance in one variable explained by the presence of the other variable. Thus $.195^2 = .038$, which is obviously a weak explanatory variable.

It is interesting to note from Table 2 that the restaurant environment was moderately correlated with food, server, service, and meal. Furthermore, the environment was not significantly correlated with the dining experience, or any of the other three variables (frequency of dining there, dining out, and expected return). The perception of the food correlated highly with perceptions of the server

Table 2. Correlations Among Variables for all Three Restaurants Combined

$r \geq .195$ significant at $p < .05$

| | (1) Restaurant Environment | (2) Food | (3) Server | (4) Service | (5) Meal | (6) Dining Experience | (7) Frequency of Dining at that Restaurant | (8) Frequency of Dining Out | (9) How Soon Expecting to Return |
|---|---|---|---|---|---|---|---|---|---|
| (1) Restaurant Environment | | | | | | | | | |
| (2) Food | .382 | | | | | | | | |
| (3) Server | .402 | .567 | | | | | | | |
| (4) Service | .301 | .316 | .304 | | | | | | |
| (5) Meal | .335 | .401 | .257 | .137 | | | | | |
| (6) Dining Experience | .115 | .449 | .407 | .361 | .254 | | | | |
| Frequency of Dining at that Restaurant | .075 | .176 | .336 | .091 | .028 | .080 | | | |
| Frequency of Dining Out | .001 | -.013 | -.036 | -.036 | .006 | -.222 | .085 | | |
| How Soon Expecting to Return | .084 | .344 | .420 | .257 | .134 | .245 | .585 | .129 | |

(r = .567), and significantly with service, meal, and dining experience. Again, there was no significant relationship among the three remaining variables.

As well as being significantly related to the environment and the food, the server was also related to the service, the meal (slightly), the dining experience, and the frequency of dining at that restaurant. In addition to the relationships mentioned above, the service was moderately related to the dining experience, and slightly related to how soon the respondent expected to return. Perceptions of the meal were (as stated above) significantly related to the environment, and food, but they were also related to the dining experience. The dining experience was most strongly related to food, service, and server. The frequency of dining at the restaurant was related only to server and expected return; while the frequency of dining out was related only to expected return (as one might expect). How soon the respondent expected to return correlated with food, server, service (slightly), dining experience (slightly, and, of course, frequency of dining at the restaurant.

Because there were significant differences among the restaurants on several variables, correlations were computed for each restaurant individually. The results for the French Restaurant are presented in Table 3. For 41 degrees of freedom, a moderate correlation of .304 is statistically

Table 3. Correlations Among Variables for French Restaurant

$r \geq .304$ significant at $p < .05$

| | (1) Restaurant Environment | (2) Food | (3) Server | (4) Service | (5) Meal | (6) Dining Experience | Frequency of Dining at that Restaurant | Frequency of Dining Out | How Soon Expecting to Return |
|---|---|---|---|---|---|---|---|---|---|
| (1) Restaurant Environment | | | | | | | | | |
| (2) Food | .391 | | | | | | | | |
| (3) Server | .407 | .471 | | | | | | | |
| (4) Service | .326 | .383 | .440 | | | | | | |
| (5) Meal | .399 | .415 | .132 | .166 | | | | | |
| (6) Dining Experience | -.016 | .316 | .219 | .136 | .207 | | | | |
| Frequency of Dining at that Restaurant | .364 | .136 | .357 | .245 | -.017 | .015 | | | |
| Frequency of Dining Out | -.058 | .045 | .042 | .359 | -.026 | -.123 | -.012 | | |
| How Soon Expecting to Return | .278 | .203 | .357 | .267 | .150 | -.057 | .713 | .150 | |

significant. The results for the Truck Stop are presented in Table 4. For 24 degrees of freedom a moderate correlation of .381 would be statistically significant. Finally, the results for the Fast Food are presented in Table 5. In this case, with 26 degrees of freedom, a correlation of .381 is also needed for significance.

The pattern of results for the restaurants considered separately is similar to that of the overall correlations. But, there are several important differences. The restaurant environment was significantly correlated with the server for the French Restaurant, but was not for the Truck Stop. While the food was significantly correlated with several of the other subscales for the French Restaurant and Truck Stop, it had a significant relationship with only the environment subscale for Fast Food.

As stated above, the server for the French Restaurant was strongly correlated with the restaurant environment, while the server for the Truck Stop was not significantly correlated with the environment. Also, for the French Restaurant the server subscale was poorly correlated with the dining experience subscale, while for the Truck Stop there was a significant relationship between those subscales. Finally, the service subscale was positvely correlated significantly with the dining experience subscale for the Truck Stop, but not for the French Restaurant or Fast Food.

Table 4. Correlations Among Variables for Truck Stop

$r \geq .381$ significant at $p < .05$

| | (1) Restaurant Environment | (2) Food | (3) Server | (4) Service | (5) Meal | (6) Dining Experience | Frequency of Dining at that Restaurant | Frequency of Dining Out | How Soon Expecting to Return |
|---|---|---|---|---|---|---|---|---|---|
| (1) Restaurant Environment | | | | | | | | | |
| (2) Food | .429 | | | | | | | | |
| (3) Server | .295 | .431 | | | | | | | |
| (4) Service | .462 | .365 | .396 | | | | | | |
| (5) Meal | .299 | .265 | .133 | .063 | | | | | |
| (6) Dining Experience | .260 | .387 | .459 | .443 | .084 | | | | |
| Frequency of Dining at that Restaurant | .063 | .240 | .355 | .124 | .063 | .174 | | | |
| Frequency of Dining Out | .175 | .152 | .001 | -.060 | .123 | -.109 | .174 | | |
| How Soon Expecting to Return | .373 | .429 | .554 | .354 | .222 | .395 | .317 | .337 | |

Table 5. Correlations Among Variables for Fast Food (Variable 3 Omitted)

$r \geq .381$ significant at $p < .05$

| | (1) Restaurant Environment | (2) Food | (3) Server | (4) Service | (5) Meal | (6) Dining Experience | Frequency of Dining at that Restaurant | Frequency of Dining Out | How Soon Expecting to Return |
|---|---|---|---|---|---|---|---|---|---|
| (1) Restaurant Environment | | | | | | | | | |
| (2) Food | .594 | | | | | | | | |
| (3) Server | | | | | | | | | |
| (4) Service | .341 | .272 | | | | | | | |
| (5) Meal | -.152 | .078 | | -.115 | | | | | |
| (6) Dining Experience | -.188 | -.196 | | -.685 | .507 | | | | |
| Frequency of Dining at that Restaurant | -.456 | -.144 | | -.350 | .092 | -.458 | | | |
| Frequency of Dining Out | .545 | .562 | | .742 | -.040 | -.594 | .263 | | |
| How Soon Expecting to Return | .382 | .414 | | .300 | .067 | -.299 | .645 | -.040 | |

## Discussion

The analysis of variance for the three restaurants showed that the server and service were not perceived differentially at the two restaurants. (Recall that there was no server at the Fast Food.) Thus any differences in the correlations between server, service, and the other variables among the three restaurants is probably due to the guests' perceptions of the server and service in relation to the particular restaurant, and not to initial differences in the way any one server was perceived. It is interesting to note that the restaurant environment of the Truck Stop was evaluated more favorably than that of the French Restaurant or Fast Food. Perhaps this was a function of the type of diners at the different establishments. The only data available on the diners indicated that the French Restaurant guests dined more frequently at their restaurant than did the guests of the other two restaurants. There was no significant differences among the guests on the rate of dining out. However, the French Restaurant dining experience was perceived more favorably than the other two restaurants, as was the food. Why these aspects of the dining event were more favorably perceived and not others is open to further investigation.

The relationship between the perception of the server and the perception of the service was moderately strong, indicating that the two were viewed as being relatively similar. However, the fact that they were not as strongly correlated as they could have been would support the hypothesis that the server and service are not seen as precisely the same things. One possible explanation is that the server is viewed as an individual who can interact with the guest, while the service cannot. The fact that the service was more highly correlated with the server at the more formal French Restaurant than at the less formal Truck Stop would tend to support this speculation. At the Truck Stop, the less formal level of interaction between the guest and server allows the guest to personalize the server, thus facilitating the separation of the server from the service. At the French Restaurant the more formal interaction prevents the guest from separating the server from the service as easily.

Overall the server was moderately, but significantly correlated with the restaurant environment, food, dining experience, frequency of dining at that restaurant, and how soon the guest expected to return. Correlations do not necessarily imply direction; therefore, it might have been (for example) a positive evaluation of the food that resulted in the positive evaluation of the server. But the overall pattern of correlations does not indicate this. Rather, differences in the correlations among the restaurants tend to indicate that perceptions of the server and service were the more causal factors. It is interesting to note that for the French Restaurant the server and service had a weak relationship to the dining experience, while for the Truck Stop the opposite was true. There, the server had a weak correlation with the restaurant environment, while the service had a strong correlation with it.

For both the Truck Stop and the French Restaurant the server was more highly related to the guests expected return than was the service. This result also indicates that the server is viewed as someone to interact with, as opposed to being depersonalized. The comparison of Fast Food and the other two restaurants supports this supposition. In this case there was no formal server, only the counter personnel with which to place an order, and pick it up. Here the service was negatively correlated with the dining experience, and was only strongly correlated with the frequency of dining out.

Clearly then, the guest's perceptions of the server are important to his perceptions of other aspects of the dining experience. However, this relationship is a complex one and bears further investigation. Especially interesting is the relationship between the server and service. In this study they were perceived in similar ways and yet differed in correlation with the other perceptions of the dining event, depending on the formality of the service at the restaurant. The implications of this study for the training of servers would seem to center around the finding that perceptions of the server are related to general perceptions, and that the guest can separate the server from the service. Training centered around human interaction and self-presentation appear to be indicated. Moreover, research into the social psychological aspects of the interaction would help isolate the specifics of the interaction training to be given.

# Appendix A

## The Questionnaire

Department of Man-Environment Relations
The Pennsylvania State University

## RESTAURANT ENVIRONMENTS

Restaurant Name: ______________________

Date: ______________________

Please answer the following questions as accurately as possible. Each question is rated on a five interval bipolar scale; for example, in asking the question:

Do you think this restaurant is:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A. | Pleasant | [✓ II] | I | 0 | I | II | Unpleasant |
| B. | Pleasant | II | [✓ I] | 0 | I | II | Unpleasant |
| C. | Pleasant | II | I | [✓ 0] | I | II | Unpleasant |
| D. | Pleasant | II | I | 0 | [✓ I] | II | Unpleasant |
| E. | Pleasant | II | I | 0 | I | [✓ II] | Unpleasant |

If you think the restaurant is quite pleasant then circle the mark "II" as shown in example "A" above; if it is somewhat pleasant, circle "I" as shown in example "B" above; and if it is neither pleasant nor unpleasant, circle "0" as shown in "C" above. If the restaurant is somewhat unpleasant, circle "I" as shown in example "D" above and if quite unpleasant, circle "II" as in "E" above

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Please circle the number of diners in party: 1, 2, 3 to 4, 5 to 8, 9 or more

1. Do you think that this restaurant is:

| | | | | | | |
|---|---|---|---|---|---|---|
| Comfortable | II | I | 0 | I | II | Uncomfortable |
| Colorful | II | I | 0 | I | II | Drab |
| Unattractive | II | I | 0 | I | II | Attractive |
| Appropriate Temperature | II | I | 0 | I | II | Inappropriate Temperature |
| Inviting | II | I | 0 | I | II | Uninviting |
| Friently | II | I | 0 | I | II | Unfriendly |
| Noisy | II | I | 0 | I | II | Quiet |

| | | | | | | |
|---|---|---|---|---|---|---|
| Poor Ventilation | II | I | 0 | I | II | Good Ventilation |
| Unstylish | II | I | 0 | I | II | Stylish |

II. Did you think that the food was:

| | | | | | | |
|---|---|---|---|---|---|---|
| Filling | II | I | 0 | I | II | Not enough |
| Flavorful | II | I | 0 | I | II | Bland |
| Warm | II | I | 0 | I | II | Cold (hot dishes) |
| Unenjoyable | II | I | 0 | I | II | Enjoyable |
| Unappetizing | II | I | 0 | I | II | Appetizing |

III. Was your server:

| | | | | | | |
|---|---|---|---|---|---|---|
| Patient | II | I | 0 | I | II | Impatient |
| Attentive | II | I | 0 | I | II | Unattentive |
| Impersonal | II | I | 0 | I | II | Personal |
| Friendly | II | I | 0 | I | II | Unfriendly |
| Responsive | II | I | 0 | I | II | Unresponsive |
| Gloomy | II | I | 0 | I | II | Cheerful |
| Cold | II | I | 0 | I | II | Warm |
| Unconcerned | II | I | 0 | I | II | Concerned |
| Careless | II | I | 0 | I | II | Careful |
| Sympathetic | II | I | 0 | I | II | Unsympathetic |
| Polite | II | I | 0 | I | II | Impolite |
| Insensitive | II | I | 0 | I | II | Sensitive |
| Knowledgeable | II | I | 0 | I | II | Unknowledgeable |

IV. Was the service:

| | | |
|---|---|---|
| Efficient | II I 0 I II | Inefficient |
| Disorganized | II I 0 I II | Organized |
| Not Clean | II I 0 I II | Clean |
| Fast | II I 0 I II | Slow |
| Correct | II I 0 I II | Incorrect |

V. Was your dining experience today:

| | | |
|---|---|---|
| Pleasant | II I 0 I II | Unpleasant |
| Good | II I 0 I II | Bad |
| Unsatisfactory | II I 0 I II | Satisfactory |

VI. How soon are you likely to return to this restaurant:

| | | |
|---|---|---|
| Very soon | II I 0 I II | Never |

VII. How frequently do you eat here:

| | | |
|---|---|---|
| Very often | II I 0 I II | Occasionally |

VIII. Was your meal:

| | | |
|---|---|---|
| Prepared Correctly | II I 0 I II | Prepared Incorrectly |
| Served Incorrectly | II I 0 I II | Served Correctly |

IX. How often do you usually dine out (check one):

a. Twice or more each week

b. Once a week

c. Once or twice a month

d. Once every few months

e. Few times a year

# A NUTRITIONAL ANALYSIS OF CONSUMER CHOICES IN FAST FOOD RESTAURANTS

by

Coleen Patterson Greecher, M.S., R.D.

# A NUTRITIONAL ANALYSIS OF CONSUMER CHOICES IN FAST FOOD RESTAURANTS

## Introduction

"Eating out is an ingrained part of American social life. This industry is definitely out of the 'special occasion only' category and into mass marketing" (1). This is indeed the case as expenditures for away from home food consumption indicate. In 1960 the consumer price index for food away from home was 81.4; in 1973, it had jumped to 135.7 (2). The 1973 figure appears significantly larger than the '63 figure. While outside home food expenditure has increased in total amount, inflation has also affected the value of money spent.

Increases in outside the home food expenditures logically indicate increased consumption of food from public establishments. The reasons for this are many, but they are basically concerned with changes in eating patterns due to our fast paced, convenience oriented society (3). Changing American food habits are clearly reflected in the rise and continuing success of fast food service establishments. A National Restaurant Association survey showed sales of specialty restaurants increased 53.1 percent between 1967 and 1970 (4). These types of eating places offer fast service, popular foods at reasonable prices, and convenience.

Of concern to nutritionists and health personnel is the nutrient variety available from combinations of food sold at fast food establishments. If these food combinations are to replace traditional meals, the amount of nutrients provided should meet nutrient requirements as easily and as well as those meals being replaced.

The purpose of this study was to determine the extent that randomly selected individuals from two different populations depend on fast food items for nutrients. The nutrient intake of the random consumers was evaluated to determine if adequate nutriture was being achieved.

### The Increase in Snack-Type Eating

In February 1974, the Executive Board of the American Dietetics Association approved for publication a position paper on nutrition education and fast food service. This paper was drafted as a result of survey reports stating that more adolescents and families with middle or lower incomes are eating fewer meals at home and more snack-type meals at fast food restaurants (5). This fact causes some concern about the nutrient intake of such individuals.

The trend toward eating outside the home, thus breaking down the traditional family-oriented three meals per day pattern extends back to the early 1950's (3). This trend was precipitated by a heretofore unknown affluence in the United States, which led to changed life styles. Per capita disposable income steadily climbed, the desire for leisure increased and increased numbers of women worked outside the home. Call (3) has stated that these factors gradually led to more meals eaten away from home, more meals eaten on the run, more snacking and less actual food preparation in the home. Concurrently, affluence was affecting the food service industry. Higher wages were required to satisfy labor demands. Increased labor and hikes in production and distribution costs resulted in drastic reductions in profits to operators. Increased costs were either passed along to the consumer by higher service prices or the operator shifted production systems to decrease labor needs (6). In the early 1960's franchise restaurants with their limited menus, emphasis on short order items, and fast turnover revolutionized the food service industry (7).

## Factors Affecting Fast Food Restaurant Popularity

Franchising prospered and grew in popularity. Sherck estimated in 1971 that of 145,000 restaurants in the United States, approximately 30,000 were franchised fast food service establishments (8). These restaurants now account for 30 percent of the American food dollar (9). In trying to determine why fast food restaurants are popular, one must examine many factors. These restaurants have created a national and regional consumer franchise through standardization of individual restaurants and maintenance of consistent quality, quantity, and service standards. They have coordinated national, regional, and local marketing programs and have effectively and creatively used advertising media (4). Consumers have been exposed to such an abundance of information about fast food restaurants that they have formed expectations about the type of food, quality, service, and cost. These factors point to the continued success of fast food restaurants.

Today's American population is fast paced. People are spending shorter hours at work and have more leisure time. Many demands are made on that leisure time: a so-called "poverty of time" is experienced and priorities for utilizing time must be set (10). Often meal preparation is seen as one area that can be eliminated or cut back to consume as little time as possible. Meals or snacks eaten at fast food restaurants are available for fast consumption--with no time expended for preparation or cleanup. In this type of situation, time achieves priority over money.

Forty-four percent of the women in the United States were working outside the home in 1973 (11). This trend has not only cut down on the amount of time available for the woman to prepare home-cooked meals, but it has also given the family more income to be used for outside home food consumption. It is important to note that for many people, like some working wives, eating out is not discretionary. Rather they prefer to dine out and to dispense with preparation and cleanup (12).

Today's life styles are shaped to a great extent by a trend toward urbanization. Gone is the agrarian habit of gathering the family together to eat three hearty meals a day. Breakfast is commonly eaten as the various family members rush to work or school. Lunch has become a meal eaten away from home due to time and travel constraints. Dinner may be the one meal for which the family is together (1, 8). With increased mobility, individuals often are not near home at mealtime, and fast food restaurants are available in convenient locations to serve a quick meal to the traveler.

A frequent reason for "eating out" is the desire to be removed from the ordinary (1, 8). One factor that determines how often this is to be experienced is cost. Although, all restaurants have the advantage of bulk purchasing at wholesale prices, the types of services offered determine how much cost is passed on to the consumer. Traditional restaurants provide menu variety, personal service, distinctive appointments and decor. By standardizing decor, limiting menu and service, and limiting personnel, fast food restaurants are able to keep consumer costs relatively low. Such practices allow prices to approximate closely home preparation costs (12).

## New Markets for Fast Food Restaurants

Because the fast food industry originally grew on its appeal to a mobile, youthful market, most of the franchise units were located along major highways and in suburban areas, where the young mobile population was concentrated (13). Recently major franchise corporations have encouraged the development of inner city markets, due to steadily depleting prime highway locations and to the impact of energy shortages. Shortages have decreased travel and therefore, fast food business (13, 14). Franchisers believe that the business district is a viable market for fast food restaurants. Inner city residents generally fall into lower income categories, and fast food restaurants can offer these residents the experience of "eating out" at affordable prices (15).

A potential boost to inner city fast food restaurants is the moderate income market that frequents the inner city by day--shoppers, secretaries, and businessmen (13). Experience to date with urban locations leaves no room to doubt the customer draw of such locations (16). There is some reason to conclude that major fast service chains will, in time, achieve a larger total volume in urban locations than in traditional highway locations (16).

Urban centers are not without problems. Security is a much greater problem in these areas (13, 15). Rental rates are higher (13). And a higher sales volume is needed to help defray the costs of added security and higher rent. Moreover, franchisers in some urban locations have encountered resistance from local residents. The residents' objections have been based, not necessarily on the food being served, but on the atmosphere that goes along with a fast food restaurant. They stress littering, loitering, and noise (17). This indigenous resistance may prove to be a significant obstacle to fast food development in urban areas.

Other critics of fast food restaurants have objected to the use of throw-away paper wrappers and bags. One specific fast food restaurant alone consumes 174 million pounds of paper per year (9). This is seen to be undesirable ecologically, as well as aesthetically.

## The Nutritional Value of the Fast Food Menu

Fast Food service restaurants typically feature food that is easily prepared, quickly eaten, and popular. Volume sales records show that the most popular restaurants are those specializing in hamburgers and fried chicken, with the accompanying french fries, milk shakes, and soft drinks (18). In the past, these establishments have made no claim of offering good nutrition (19), and nutritional data on franchise food has been sparse (20, 21). Recently, a major fast food corporation has started to publish a nutritional breakdown of its food as a form of advertisement. The breakdown is based on an analysis conducted by the Warf Research Institute (22). Researchers collected samples of every item sold from seven fast food restaurants located across the United States. The 100-gram samples were analyzed for content of protein, fat, carbohydrates, ash, moisture, fiber, calories, ten vitamins, and 15 minerals. Analysis focused on the actual product weight for protein, carbohydrate, fat, and the major vitamins and minerals. The researchers made tabulations of the percentage of Recommended Dietary Allowances (RDA) certain items satisfied for a 14 to 18 year old male, as well as percentage of United States Recommended Dietary Allowance (USRDA). The sample meals chosen showed approximately one-third of the RDA for most nutrients, but all were extremely low in Vitamin A. Some combinations were low in Vitamin C (less than one-third) and iron. It is interesting that all reference combinations included a milk shake and not a soft drink. Milk shakes obviously upgrade the nutrient content of a meal, whereas soft drinks offer negligible nutrient content.

Another analysis, this of several fast food restaurants, was conducted in Gainesville, Florida, and was published in April 1974 (23). It included a proximate analysis based on item weight and 100-gram samples, mineral composition on item weight and 100 grams, and some nutrient values for fast food meal combinations. The values were compared to the RDA for selected age groups. Finally, the study compared the nutrient content of a specific fast food restaurant, with already established nutrient data. The researchers found that the amounts of energy, protein, fat, and carbohydrate in food were quite similar regardless of the restaurant they chose. Consumption of the specialty item, french fries, and a milk shake by a 7 to 10 year old child was found to be adequate in all nutrients studied, except for iron in some restaurants. Vitamin content was not, however, dealt with in this particular study (23).

Chem and LaChance attempted to evaluate the nutritive profile of the typical fast food meal of four different fast food restaurants in terms of the contribution of each to the RDA. They dealt with eight nutrients: protein, calcium, iron, Vitamin A, thiamin, riboflavin, niacin, and Vitamin C. A meal of one hamburger, a regular order of french fries, and a soft drink was found to contain less than one-third of the RDA for all nutrients analyzed. But the substituting of a milk shake for the soft drink improved calcium, protein, riboflavin, and niacin values to acceptable levels. Chem and LaChance observed that all hamburger meals were deficient in Vitamin A. Vitamin C levels were low unless certain specialty hamburgers were chosen. These authors recommend fortification of ketchup with Vitamins A and C. But this method of introducing limiting nutrients into fast food meals is potentially harmful to certain high risk people. Ketchup is usually consumed in very limited quantities. The benefit derived from fortification of such an item is questionable. The suggestion to encourage promotion of at least one nutritious combination from each fast food restaurant has more merit (21).

These attempts to record the nutrient content of limited menu foods represent only rough averages. Nutrient analysis of fast foods is needed, not only for accuracy in advertising, but also for information as to general use. Handbook Eight, the traditional guide for determining nutritional data, does not contain information that is applicable to all fast food items, due to recent changes in animal feeding practices, breeds of animals, and processing methods (24). Nor is nutritional information about fast food content well documented. With the increased contribution of this type of food to individual diets, more information is needed to assess overall nutrient intake and nutritional adequacy.

## Nutrition Knowledge and Application

Nutritional adequacy is not always readily observed by the layman. The average homemaker-consumer has two principal bases for confidence in the nutritional adequacy of diets and eating habits: (1) whether family members are active and look healthy; and (2) whether the homemaker balances the diet by providing a variety of foods (25). With the breakdown of the traditional three meals per day pattern, the meal preparer has little control over a family's eating habits, except perhaps at dinner, where an attempt may be made to serve the variety of food deemed necessary. This "one shot a day" approach to nutritional adequacy is often unsuccessful, and the other meals or snacks consumed throughout the day at a variety of places, may contribute only minimal amounts of important nutrients.

There is reason to believe that the average consumer may not be knowledgeable enough about nutrient content to choose nutritious snacks and meals. Bauman stated that "consumers in general show a lack of knowledge about the constitution of well-balanced diets, and have an inadequate conception of common food sources of important nutrients" (25). This observation, as well as the feeling that it is easier to pick a bad diet today than to choose a good diet (20), indicates that guides should be established so that consumers can be aware of the nutrient quality of the food they are eating, especially away from home. The nutritional analysis of fast food items serves as a step in this direction.

It has been frequently suggested that the responsibility for providing nutritious meals should rest heavily on the food service industry. More responsibility may be allocated to fast food restaurants if current legislation is passed which would require nutrient labeling of food if advertisements contained any reference to nutrition (26).

In the past, the industry has been criticized for neglecting to provide adequate amounts of fresh fruits, properly cooked vegetables, substitutes for traditional breakfast eggs, and information about fats used for frying (27). This neglect is seen as affecting the consumer's opportunity to choose a nutritious meal. It is also felt that when an establishment like a fast food restaurant serves large numbers of people, it can be easier to ignore nutrition and concentrate on getting out the quantity of food needed (28).

Individuals surveyed in Los Angeles felt that eating at home was the best way to provide good nutrition (29). While these people may not represent all consumers, it seems obvious that since outside home food consumption is rising, good nutrition is not the first priority of consumers in deciding where to eat.

Previous studies on fast food nutritional adequacy have analyzed the nutrient content of sample meals. This type of study is important because it provides knowledge about the presence of specific nutrient components. But not every consumer chooses that sample meal when eating at the fast food restaurant. Investigations are needed which deal with actual consumer choices. By studying individual choices, it may be possible to see emerging trends in food choices, the resultant nutrient intake, and dependence on the fast food meal for nutrients.

## The Objectives of this Study

The primary objective of this study will be to ascertain the percentage of meals individuals eat in a particular fast food restaurant in the downtown area of two different communities--one a university town, the other a small city area. Meals consumed will be evaluated nutritionally using data obtained by the Warf Institute for a specific fast food restaurant. This data will reveal if meals inadequate in certain nutrients are commonly chosen.

A second objective will be to determine if any relationship exists among the number of meals eaten away from home, the age and sex of patrons, the cooking facilities they have available, and classification of food eaten as a meal or as a snack. Knowledge of the relationships among these factors will help to determine if specific age and sex groups frequent fast food restaurants. It will also show if any difference exists between respondents in each location as to the number of times per week fast food restaurants are visited.

A knowledge of the availability of cooking facilities will be used to determine whether customers eat at fast food restaurants because they have no way of preparing food themselves. Information as to whether respondents consider a fast food restaurant contact as a meal or as a snack will indicate how heavily the consumer depends on fast food items for nutrient intake.

If this study reveals that meals inadequate in certain nutrients are commonly chosen, then the data should be used to justify a follow up study to determine if the choice is due to a lack of nutrition knowledge, indifference to nutrition, or some other reason.

## Method

### Description of Measure

The goal of a fast food restaurant is to minimize the cost of serving food, in terms of both time and money. In order to collect information from fast food customers, it was thought advantageous to proceed in a like manner. The author developed a short questionnaire to administer to random fast food customers. The questionnaire was designed to ascertain the age and sex of the customer and availability of cooking facilities. Customers were also asked if they considered the food they consumed at the restaurant to be a meal or snack, how often they ate at this particular fast food restaurant, how often they ate at other fast food restaurants, and what foods they chose. A copy of the questionnaire appears as Appendix A.

Each of the items on the questionnaire was included for a specific purpose. Age and sex were necessary to classify each respondent and to provide a comparison of each individual to standardized reference tables. A question on cooking facilities was included to determine if this factor influenced the number of times individuals ate at fast food restaurants. Customers were asked if they considered their immediate intake of fast food a meal or a snack to ascertain how heavily that food was responsible for total daily nutrient intake. The questions on frequency of eating at the specific fast food restaurant and other such fast food restaurants represented an effort to determine how heavily the patron depended on fast food for long term nutrient intake. Food choices were recorded in order to evaluate one "meal" or "snack" for total nutrients.

One criticism of the questionnaire might be the fact that it made no provision for determining eating patterns and nutrient intake, other than for one restaurant meal. It is recognized that some type of diet history would have been helpful and would have provided a more sound basis for recommendations. But a more important goal, that of receiving cooperation from customers, was achieved. If the customers were asked to answer the questionnaire plus give a 24-hour recall or 3-day food record, they would probably have been unwilling to participate. And a smaller number of participants would have diminished the reliability of any inferences made.

## The Testing Situation

Two fast food restaurants of the same chain were used as test centers--one in State College, Pennsylvania, and one in downtown Johnstown, Pennsylvania. These testing centers were selected for specific reasons: The author felt the State College site would be representative of the food choices of a youthful population, mainly the 19 to 22 age group. The author hypothesized that this age group would frequent fast food restaurants more than any other. The Johnstown site was selected (1) because the operation was located in the heart of the city, and (2) because the author felt that a more representative sample of the United States population could be attained in this center than in a university town.

Prior to the commencement of data collection, the author pilot tested a measuring instrument in the State College store for possible ambiguities. Small corrections were made to clarify certain questions on the instrument.

Data was collected identically in each center, with the exception that different interviewers were used. The interviewer was stationed outside the restaurant doors. As a customer emerged from the restaurant, he was approached and asked if he would be willing to answer a few questions for a research study concerning food choices. Individuals who stated they worked at the restaurant were excluded as were individuals who had not just previously ordered food for their own consumption.

If the individual had ordered food and consented to be interviewed, the questions plus the answer choices were read to him. The interviewer checked the appropriate answers on the questionnaire.

Interviewing was scheduled in such a way as to achieve a random sampling of all the restaurants' customers. This was accomplished by devising an interview schedule to cover 15 hours of the day--from 7 A.M. to 10 P.M. A copy of the schedule is included as Appendix B.

Interviews were conducted for seven consecutive days encompassing two three-hour periods per day. Ten persons were interviewed in each three-hour period with a total of 20 interviews per day. The interviewer remained at her post outside the restaurant during the three-hour periods for as long as it took to obtain ten responses. In the total study, 280 persons were interviewed, 140 at each site.

Questionnaire Analysis

The questionnaire responses were coded. The nutrient content of each customer's food choices was calculated with the nutrient data for a specific fast food restaurant provided by Warf Institute (22). Values for orange juice and large french fries were provided by a fast food corporation. Values for cider, milk, English muffins, cookies, and hot chocolate were derived from the United States Department of Agriculture's Handbook Eight (30) because values for these foods were not available in the Warf study.

One-third of the RDA was calculated for each age and sex group as a standard reference.

This investigation recorded only one meal's intake per day. One meal can be seen to represent approximately one-third of a total day's food intake and, therefore, approximately one-third of the nutrient intake. For this reason, one-third RDA was used as a standard to measure the nutritional adequacy of the one meal recorded.

The author recognized that not all individuals would consider the food eaten as a meal but would consider it, rather, as a snack. Therefore, some standard was needed to evaluate the nutritional adequacy of the snack. The arbitrary value chosen was one-fourth RDA, because it was assumed that a snack would be less substantial than a meal.

Questionnaire data was analyzed with two statistical tests. The Chi-square test was used to determine if relationships existed between demographic data and availability of a cooking facility, consideration of intake as a meal or a snack, and frequency of consumption of fast food restaurant meals. The data collected at the two sites was compared using an analysis of variance. Observed differences between meal values were tested for significance with the Fisher test.

## The Results of the Study

### Questionnaire Data

The demographic characteristics of 280 respondents are presented in Table 1. Males comprised 56 percent of the total sample, whereas females comprised 44 percent. Subjects in the age group from 19 to 22 years constituted the greatest percentage (35 percent) of individuals interviewed, with the 23 to 50 year age group only slightly less (30 percent).

The results of Chi-square analysis applied to demographic and interview data are presented in Tables 2 and 3. The Johnstown and State College populations differed significantly in regard to availability of cooking facilities, consideration of the food choices as a meal or snack, and the number of weekly visits to a specific fast food restaurant, respectively. Age groups differed in regard to availability of cooking facilities, as well as to consideration of food choices as a meal or snack. The number of times an individual ate at fast food restaurants other than one specific fast food restaurant differed between male and female consumers.

Table 1. Demographic Characteristics

| Sex | Age (Years) | Number | % of Total Sample |
|---|---|---|---|
| Male | 0-10 | 3 | 1.1 |
| | 11-14 | 4 | 1.4 |
| | 15-18 | 21 | 7.5 |
| | 19-22 | 55 | 19.6 |
| | 23-50 | 48 | 17.1 |
| | $51^+$ | 26 | 9.3 |
| | All ages | 157 | 56 |
| Female | 0-10 | 4 | 1.4 |
| | 11-14 | 13 | 4.7 |
| | 15-18 | 20 | 7.2 |
| | 19-22 | 40 | 14.3 |
| | 23-50 | 35 | 12.5 |
| | $51^+$ | 11 | 3.9 |
| | All ages | 123 | 44 |

## Table 2. Availability of Cooking Facilities and Consideration of Intake as a Meal or Snack

| Demographic Characteristics | Cooking Facilities[a] | | Meal[b] | Snack[b] |
|---|---|---|---|---|
| Sex | Yes | No | | |
| Male | 121 | 36 | 80 | 77 |
| Female | 97 | 26 | 67 | 56 |
| Location | | | | |
| State College | 97 | 43 | 101 | 39 |
| Johnstown | 121 | 19 | 46 | 94 |
| Age | | | | |
| 0-10 years | 7 | 0 | 4 | 3 |
| 11-14 years | 17 | 0 | 7 | 10 |
| 15-18 years | 29 | 12 | 24 | 17 |
| 19-22 years | 65 | 30 | 64 | 31 |
| 23-50 years | 63 | 20 | 42 | 41 |
| $51^+$ years | 37 | 0 | 6 | 31 |

[a] The availability of cooking facilities was found to be significantly different ($p < .001$) in regard to location and age group.

[b] The consideration of food intake as a meal or a snack was found to be significantly different ($p < .001$) in regard to location and age group.

## Table 3. Frequency of Fast Food Consumption

| Demographic Characteristics | Number of times ate at specific fast food restaurant per week[a] | | | | | Number of times ate at other fast food restaurant per week | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Less than 1 | 1-3 | 3-6 | 6-10 | More than 10 | Less than 1 | 1-3 | 3-6 | 6-10 | More than 10 |
| Sex | | | | | | | | | | |
| Male | 59 | 56 | 25 | 13 | 4 | 74 | 54 | 19 | 7 | 3 |
| Female | 49 | 50 | 12 | 12 | 0 | 78 | 34 | 4 | 6 | 1 |
| Location | | | | | | | | | | |
| State College | 75 | 46 | 17 | 2 | 0 | 80 | 45 | 12 | 2 | 1 |
| Johnstown | 33 | 60 | 20 | 23 | 4 | 72 | 43 | 11 | 11 | 3 |
| Age | | | | | | | | | | |
| 0-10 years | 4 | 1 | 0 | 2 | 0 | 5 | 0 | 1 | 1 | 0 |
| 11-14 years | 6 | 10 | 0 | 1 | 0 | 12 | 5 | 0 | 0 | 0 |
| 15-18 years | 14 | 15 | 8 | 3 | 1 | 21 | 10 | 7 | 3 | 0 |
| 19-22 years | 41 | 32 | 16 | 6 | 0 | 49 | 33 | 8 | 4 | 1 |
| 23-50 years | 32 | 34 | 10 | 5 | 2 | 46 | 29 | 5 | 2 | 1 |
| $51^+$ years | 11 | 14 | 3 | 8 | 1 | 19 | 11 | 2 | 3 | 2 |

[a] The number of times a subject ate at one specific fast food restaurant per week was found to be significantly different ($p = < .001$) in regard to location.

Most State College respondents ate at one specific fast food restaurant less than once a week (as shown in Table 3), whereas most Johnstown respondents ate at one specific fast food restaurant one to three times per week ($p < 0.001$). More State College respondents considered the food eaten at one specific fast food restaurant as a meal (72 percent of 140, Table 2) but more Johnstown respondents considered the food eaten at one specific fast food restaurant to be a snack (67 percent of 140) ($p < 0.001$).

There was a significant difference among age groups in regard to whether the food purchased at one specific fast food restaurant was a meal or a snack ($p < 0.001$), as shown in Table 2. The individuals in the age group 19 to 22 ate more meals than snacks, the 23 to 50 age group ate almost the same number of snacks as meals, and the 51 and over group ate more snacks than meals. Of the Johnstown people surveyed, 86 percent had cooking facilities, whereas 69 percent of the State College respondents had cooking facilities ($p < 0.001$).

French fries, soft drinks, and coffee were by far the most frequently ordered items. In all, 121 servings of french fries, 115 servings of soft drinks, and 80 cups of coffee were ordered. French fries and soft drinks were ordered most frequently by the age groups 15 to 18 and 19 to 22. Thirty cups of coffee were ordered by the 37 consumers in the $51^+$ group. This age group was solely composed of Johnstown respondents. The Johnstown 23 to 50 group consumed twice as much coffee as the same age group from State College.

Sandwich orders varied. The State College 19 to 22 group ordered large sandwiches, whereas the same age group from Johnstown ordered more cheeseburgers and hamburgers. The State College 23 to 50 group consumed more specialty sandwiches, soft drinks, and french fries than the Johnstown group of the same age. The 51+ group purchased very few specialty sandwiches. The most frequently ordered sandwich of this group was the hamburger.

The mean intake of eight nutrients, classified as to location and sex is shown in Table 4. It is evident that the State College respondents ingested larger amounts of all nutrients. When significant differences between the intakes of the two populations were found, age group data were examined with the Fisher test to determine if the differences were more pronounced among certain age groups. The nutrient intake of each age and sex group is shown in Tables 5 through 12.

Figure 1 presents information as to how the respondents' nutrient intake compared to one-third of the RDA for age and sex. This amount was chosen as the standard because data was collected for only one food intake per day. If it is assumed that the general eating pattern is three meals per day, and the RDA is set for one day, then one-third of the RDA would equal the recommendation for one meal of the day. For seven of the eight nutrients studied, a very high percentage of the respondents received less than one-fourth of the RDA for their age and sex group. The only nutrient for which the majority of subjects received greater than one-third RDA was protein. It is particularly significant to observe that 99 percent of the 280 respondents received less than one-fourth of the RDA for their age and sex for Vitamin A.

## Discussion

This study had two purposes: to determine how heavily consumers depended on fast food products for nutrients; and to determine how nutritionally adequate the consumer food choices were.

Table 4. Mean Nutrient Intake

| Location | Sex | Protein (gr.) | Fat (gr.) | Calories (kcal.) | Vitamin A (IU) | Vitamin C (mg.) | Thiamin (mg.) | Calcium (mg.) | Iron (mg.) |
|---|---|---|---|---|---|---|---|---|---|
| State College | Male | 20.2 | 24.3 | 548 | 265 | 12.7 | .28 | .17 | 2.98 |
| | Female | 19.5 | 23.5 | 566 | 261 | 9.7 | .52 | .18 | 2.7 |
| SUM | | 39.7[a] | 47.8 | 1114[b] | 526 | 22.4 | .80[a] | .35 | 5.68[b] |
| Johnstown | Male | 12.1 | 18.6 | 381 | 179 | 8.5 | .19 | .11 | 1.76 |
| | Female | 13.7 | 17.7 | 426 | 198 | 8.5 | .20 | .13 | 1.9 |
| SUM | | 25.8[a] | 36.3 | 807[b] | 377 | 17.0 | .39[a] | .24 | 3.7[b] |

[a,b] Sum of values with same superscripts in vertical columns differed significantly;

$a = p < 0.01$, $b = p < 0.02$.

Table 5. Mean Protein Intake (Gms.)

| Location | Sex | 0-10 | 11-14 | 15-18 | 19-22 | 23-50 | $51^+$ |
|---|---|---|---|---|---|---|---|
| | | | | Age | | | |
| State College | Male | 25.2 | --- | $30.9^{a,b}$ | $25.1^{c}$ | $20.1^{b}$ | --- |
| | Female | 24.3 | 19.1 | 20.4 | 18.7 | 21.3 | --- |
| Johnstown | Male | 4.8 | 6.4 | 21.5 | $16.5^{a,c}$ | 11.6 | 11.5 |
| | Female | 11.3 | 12.7 | 17.1 | 19.8 | 14.7 | 6.6 |

$^{a,b,c}$ Represents significant difference ($p < .05$) between means with same superscripts.

Table 6. Mean Fat Intake (Gms.)

| Location | Sex | 0-10 | 11-14 | 15-18 | 19-22 | 23-50 | $51^+$ |
|---|---|---|---|---|---|---|---|
| | | | | Age | | | |
| State College | Male | 28.8 | --- | 35.4 | 29.6 | 23.0 | --- |
| | Female | 31.5 | 24.1 | 17.8 | 21.9 | 26.1 | --- |
| Johnstown | Male | 16.5 | 12.3 | 27.0 | 19.1 | 15.4 | 21.4 |
| | Female | 21.3 | 17.8 | 22.0 | 19.5 | 15.9 | 9.4 |

Table 7. Mean Kilocalorie Intake

| | | Age | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Sex | 0-10 | 11-14 | 15-18 | 19-22 | 23-50 | $51^+$ |
| State College | Male | 692 | 92 | $877^a$ | 674 | 516 | --- |
| | Female | 777 | 616 | $499^a$ | 530 | 579 | --- |
| Johnstown | Male | 348 | 275 | 593 | 461 | 347 | 268 |
| | Female | 519 | 444 | 521 | 483 | 388 | 203 |

[a] Represents significant difference ($p < .05$) between means with same superscript.

Table 8. Mean Vitamin A Intake (IU)

| | | Age | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Sex | 0-10 | 11-14 | 15-18 | 19-22 | 23-50 | $51^+$ |
| State College | Male | 280 | --- | 396 | 331 | 305 | --- |
| | Female | 201 | 316 | 290 | 264 | 293 | --- |
| Johnstown | Male | --- | 154 | 253 | 287 | 202 | 175 |
| | Female | $83^a$ | $172^a$ | 220 | $371^{a,b}$ | 218 | $124^b$ |

a,b Represent significant differences ($p < .05$) between means with same superscript.

Table 9. Mean Vitamin C Intake ( Mg.)

| | | Age | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Sex | 0-10 | 11-14 | 15-18 | 19-22 | 23-50 | $51^+$ |
| State College | Male | 13.4 | --- | 23.3 | 13.8 | 15.5 | --- |
| | Female | 11.8 | 12.7 | 5.1 | 8.6 | 13.3 | --- |
| Johnstown | Male | 14.4 | 8.4 | 9.4 | 6.1 | 9.0 | 3.5 |
| | Female | 16.2 | 9.3 | 7.5 | 6.8 | 8.9 | 2.3 |

Table 10. Mean Thiamin Intake (Mg.)

| | | Age | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Sex | 0-10 | 11-14 | 15-18 | 19-22 | 23-50 | $51^+$ |
| State College | Male | .33 | --- | .46[a] | .35 | .28 | --- |
| | Female | .36 | .31 | .28 | .28 | .28 | --- |
| Johnstown | Male | .18 | .12 | .28[a] | .24 | .17 | .17 |
| | Female | .27 | .19 | .21 | .27 | .20 | .008 |

[a] Represents significant differences (p .05) between means with same superscript.

Table 11. Mean Calcium Intake (Mg.)

| Location | Sex | 0-10 | 11-14 | 15-18 | 19-22 | 23-50 | $51^+$ |
|---|---|---|---|---|---|---|---|
| State College | Male | 153 | --- | 308[a] | 205 | 190 | --- |
| | Female | 329 | 146 | 195[a] | 164 | 168 | --- |
| Johnstown | Male | 15 | 139 | 168 | 112 | 128 | 77 |
| | Female | 41 | 100 | 219 | 228 | 143 | 43 |

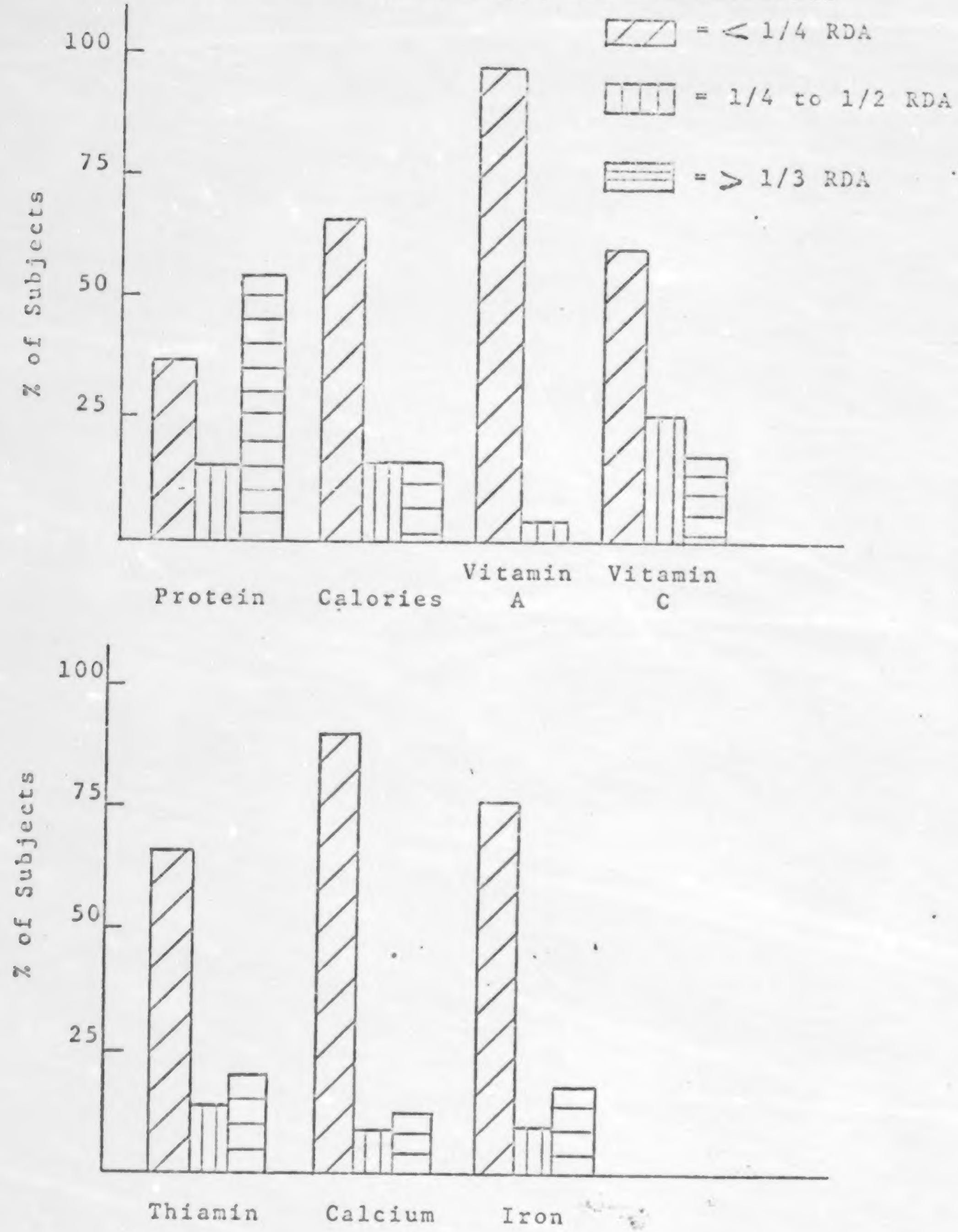
[a] Represents significant difference (p .05) between means with same superscript.

Table 12. Mean Iron Intake (Mg.)

| Location | Sex | 0-10 | 11-14 | 15-18 | 19-22 | 23-50 | $51^+$ |
|---|---|---|---|---|---|---|---|
| State College | Male | 3.7 | --- | 4.5 | 3.6 | 2.9 | --- |
| | Female | 2.8 | 2.8 | 3.0 | 2.8 | 2.9 | --- |
| Johnstown | Male | .7 | .6 | 3.1 | 2.7 | 1.6 | 1.9 |
| | Female | 2.0 | 2.1 | 2.1 | 2.2 | 2.1 | 1.1 |

FIGURE 1

Portion of RDA Received for All Nutrients



## Relation of Demographic Data to Eating Habits

Cooking Facilities. Eighty-six percent of the Johnstown respondents claimed they had access to cooking facilities, as opposed to 69 percent of the State College respondents. The reason for the 17-percent difference is probably the fact that many of the State College subjects were college students who lived on campus in dormitories. The majority of dormitories do not have cooking facilities for student use. The group consisting of people from 19 to 22 years of age constituted the largest group of all respondents--35 percent of the total population. Twice as many individuals in this age group had cooking facilities as did not, while three times as many individuals had facilities as did not in the 23 to 50 age group. This group constituted 30 percent of the total population. In the 51 and older group, 100 percent claimed to have cooking facilities. This represented 13 percent of all respondents. These figures indicate that the people in this investigation did not eat at the fast food restaurant out of necessity. The majority obviously had the means to prepare food themselves. Therefore, it is reasonable to assume that certain other factors must have influenced the choice of eating at a fast food restaurant. One of these factors might possibly have been the so-called "poverty of time" discussed by Mauser (10). Consumers may have chosen to eat at a fast food restaurant in order to save the time and effort required to prepare, eat, and clean up after a home prepared meal. The time saved might then be spent pursuing other interests.

Meal or Snack. A meal was considered by the author to be one of three major food intakes of a single day, constituting approximately one-third of the nutrients ingested per day. A snack was defined as anything taken between meals.

Most State College respondents (72 percent) considered the food they ate at a specific fast food restaurant to be a meal, whereas most Johnstown respondents (68 percent) considered the food to be a snack. Closer analysis of the data revealed that the largest concentration of the population was between the ages of 19 and 51 plus. Within this range, the age group from 19 to 22 years was shown to consume twice as many meals as snacks. Since 79 percent of the individuals in this age group were in the State College site, consumption of more meals than snacks could be accounted for by the fact that the specific fast food restaurant in State College was located at the edge of a university campus and, thus, was very accessible to student use. Again, the concept of "poverty of time" may have been involved. Students may have considered going to the fast food restaurant for a quick dinner more desirable than waiting in line to be served at a dorm cafeteria. Another possibility is that if the cafeteria served a dish that was not popular, the students may have preferred to eat at the fast food restaurant.

The group from 23 to 50 years of age ate practically as many meals as snacks. It was difficult from the available data to hypothesize reasons for this.

Of 37 respondents 51 years or older, 31 (or 84 percent) considered their consumption of fast food to be snacks rather than meals. All the individuals in this group preferred to prepare their own meals. All of the 51 and older respondents were questioned at the Johnstown restaurant. A block away from the restaurant was an apartment complex for the elderly. It is possible that the purchase of a snack at the fast food restaurant represented a pleasing social experience for these people, while economic considerations may have prevented them from purchasing an entire meal.

Number of Times Eating at a Specific Fast Food Restaurant and Other Fast Food Restaurants. Location was found to have a significant influence on the number of times per week a respondent ate at the restaurant investigated, but not on the number of times they ate at other fast food restaurants. One hundred twenty one out of 140 State College subjects surveyed ate at the specific restaurant less than once a week or from one to three times per week. For the State College sample, most of the trips to the restaurant were for the purpose of consuming meals. Because of the fact that the specific restaurant's meals were consumed relatively infrequently (they represented a maximum of one-seventh of a total week's meals) it is probably not reason for concern about nutrient intake. If the State College individuals were eating meals at a fast food restaurant more frequently, concern might be expressed for the adequacy of intake of certain nutrients.

The Johnstown respondents ate at the fast food restaurant more frequently than the State College subjects, but much more frequently they considered the food eaten there as a snack rather than a meal. Because this investigation did not include data on food other than that eaten by the subjects at the fast food restaurant, it was impossible to tell how heavily snacks contributed to total nutrient intake. It, therefore, was assumed that adequate nutrition could be achieved by other meals eaten throughout the day, and that the snack served only as a supplementary source of nutrients.

Nutrient Intake. No studies assessing actual consumer choices for nutritional adequacy have been reported. Investigators who have reported on the adequacy of fast food meals have used sample meals purchased from given restaurants and have chemically evaluated the food for nutrient content.

Results of these studies have generally shown Vitamin A to be particularly low, with marginal intakes of Vitamin C and iron (21, 23, 31). One very recent report stated that six nutrients are commonly low in fast food meals--biotin, folacin, pantothenic acid, total Vitamin A, iron, and copper. This report also dealt with sample meals rather than consumer choices (31).

The results of the study at hand support the previous findings that Vitamin A content in fast food choices is minimal. Ninety-nine percent of the individuals surveyed received less than one-fourth of the RDA for their age and sex from their food choices. Most items on the fast food restaurant's menu contain only negligible amounts of Vitamin A. The highest amount (459 IU) came from an Egg McMuffin, which was available only during certain morning hours. It would be very difficult to consume the amount of food that would be necessary to attain one-third the RDA for Vitamin A from the available choices.

This investigation is in agreement with previous studies (31), which showed Vitamin C and iron intakes to be low. Significant amounts of Vitamin C were available from orange juice. Smaller amounts were available from french fries. Males, from 15 to 18 years of age, showed a significantly higher intake of Vitamin C than the other groups. This was attributed to the consumption (within the group) of several large orders of french fries and 1 or 2 servings of orange juice. State College females in the 15 to 18 age group consumed a very low mean Vitamin C value. Reasons for this included a reluctance to order french fries and no orders of orange juice. French fry avoidance may be attributed to the weight consciousness of the teenaged females, or perhaps to concern about acne.

Individuals over 51 years of age had very low Vitamin C intakes. This was found to be due to a low consumption of Vitamin C-rich food--french fries and orange juice. Reasons for this low consumption were possibly fear of digestive upsets caused by the consumption of fried foods or high acid foods. Fear of developing or exacerbating existing atherosclerosis may have been another reason for avoiding french fries.

Seventy two percent of the individuals surveyed received less than one-fourth of the RDA for iron from the food consumed at the fast food restaurant. Females might have difficulty receiving 6 milligrams (one-third the adult female RDA for iron). The highest sources of iron are the specialty sandwiches*--all of which contain approximately 4 milligrams of iron. State College males and females ingested approximately equal amounts of iron, amounts which were greater than those of the Johnstown subjects. This might have been due to certain economic factors which would allow the State College subjects to purchase specialty sandwiches more frequently than the smaller sandwiches. There was no way to ascertain the effect of economic factors in this investigation, but it may be that since more Johnstown consumers regarded the specific fast food restaurant's food as a snack, they ate fewer big sandwiches. Individuals over 51 had exceptionally low iron intakes--this was found to be due to a large proportion of subjects ordering only coffee. If they ordered a sandwich it was generally a hamburger or a cheeseburger, rather than a specialty sandwich, which would contain more iron.

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*A specialty sandwich contains more meat than a regular sandwich (hamburger or cheeseburger) and contains more protein, calories, fat, and iron. Examples of specialty sandwiches are the quarter-pounder and the quarter-pounder with cheese.

In contrast to other studies that have evaluated the nutritional adequacy of fast food meals, this investigation showed not only sub-standard levels of Vitamin A, Vitamin C, and iron, but also suboptimal intakes of calories, calcium, and thiamin.

The Consumer Report study (31) stated that most fast food meals were high in calories--some providing up to one-half daily energy needs. Data from the present investigation stood in sharp contrast to that study. Sixty-eight percent of all respondents received less than one-fourth of the RDA for their age and sex from their food choices. Johnstown males consumed much lower levels of calories than State College males or females. Their low intakes tended to bring down the mean intake levels.

Caloric intake peaked between the ages of 15 and 18 in both State College and Johnstown, with Johnstown teenagers experiencing a slightly lower peak. This was probably due to the high energy needs for adolescent growth. In both test centers, caloric intake steadily declined from the peak, in a parallel manner, up to and including the 51 and older group. The decline logically indicates a decline in energy needs.

The findings of the current investigation concerning caloric intake were probably conflicted with those of the Consumer Report study because it examined one sample meal, whereas this study examined many different food combinations as chosen--both snacks (which might consist only of a beverage) and meals.

Very few foods on the fast food restaurant's menu can be considered good sources of calcium. Shakes (in three flavors) provide between 350 and 400 milligrams of calcium. One shake would provide approximately one-half the calcium requirement for children and adults, and one-third the requirement for adolescents (32). But shakes were not commonly chosen items. Of the 280 people surveyed, only 19 consumed shakes, as opposed to 115 servings of soft drinks and 80 cups of coffee. The soft drinks offered only calories, whereas coffee, if taken black, provided no nutritive value at all. Milk was available, as was hot chocolate, but only 13 servings of milk were ordered. A serving of milk would contribute approximately 280 milligrams of calcium--a value slightly less than that of a shake. Twenty cups of hot chocolate were consumed. The calcium value of hot chocolate was about the same as that of milk. Milk products and green leafy vegetables are generally considered to be the best sources of calcium. Since milk and shakes were not consumed in very large quantities, and green vegetables were not available, calcium intakes were generally low.

If more shakes had been consumed, calorie intakes would probably have risen, as each shake contained about 320 calories, as opposed to 92 from the soft drinks and none from black coffee.

Consumer Reports (31) has stated that fast food "shakes" contribute heavily to the high level of carbohydrate in these types of meals. It further states that they are not true milk shakes. It is true that each shake contains slightly more than 50 grams of carbohydrate. The present study did not investigate carbohydrate as such.

Of concern to some researchers is the possibility that high consumption of carbonated beverages may have a detrimental effect on the calcium to phosphorus ratio in bone. The Warf analysis of a specific fast food restaurant's food (22) did not examine carbonated beverages. Therefore, this study did not investigate the phosphorus content of soft drinks. The possibility remains that this might be a potential problem, especially for young children.

Thiamin intakes were also shown to be low, with 66 percent of those surveyed receiving less than one-fourth of the RDA for age and sex group. Low thiamin levels in this case is probably not a cause for concern, since the United States has an established enrichment program for bread and cereal products that adds significant amounts of thiamin to these foods.

The one nutrient for which the majority of consumers (54 percent) exceeded one-third of the RDA for age and sex was protein. All sandwiches on the menu were good protein sources. State College males and females consumed consistently greater amounts of protein than Johnstown males and females. This result may be attributed to the consumption of more specialty sandwiches containing greater amounts of protein.

The 51 and older females from Johnstown consumed significantly lower amounts of protein than the other Johnstown females. This was probably caused by the tendency of the older ladies to consume only coffee. Since they most often considered the fast food restaurant's food as a snack, protein consumption is probably not an issue, provided the 51 and older women receive adequate protein from meals or other snacks.

This investigation has revealed that the individuals interviewed did not consume a large proportion of meals at one specific fast food restaurant or other fast food restaurants. Therefore, they did not depend on fast food meals for large proportions of nutrients. The majority of respondents received less than one-fourth of the RDA for their sex and age, for all nutrients except protein, as a result of the one fast food intake per day.

Most consumers surveyed had available cooking facilities indicating that some other factor or factors influenced their decision to eat at a fast food restaurant.

## Conclusions

This study comes at a critical time. Fast food restaurants are receiving much unfavorable publicity because of the alleged poor nutritional value of the food they serve. This investigation has shown that adequate amounts of most nutrients (with the exception of Vitamin A) are available on the fast food menu. But consumers tend not to choose the nutrient-rich foods.

This investigation has shown that fast food restaurant meals or snacks do not make up a high proportion of the food consumed by the two sample groups selected. The State College group, which frequently considered the food eaten at the fast food restaurant as a meal, consumed a maximum of one-seventh of its total week's meals at the restaurant. The Johnstown group considered their fast food to be more snacks than meals, and the majority stated it ate there from one to three times per week.

The two sample groups cannot be considered representative of the general population of eaters in fast food restaurants. Certain characteristics of each test center's population make the surveyed groups unique. The majority of State College respondents were young adults. The Johnstown sample was unique because of its close proximity to a housing project for the elderly and to the downtown business district.

Results from this investigation cannot be generalized to the entire population of eaters in fast food restaurants. For the people surveyed, excessive consumption of fast food is not a significant problem. If these types of meals were consumed on a more frequent basis, however, nutritional problems could conceivably arise.

The movement of fast food restaurants into urban areas, college campuses, and locations readily available to school children and the elderly may not be reason for nutritional concern. But ghetto life styles could pose serious problems, particularly for children whose parents are frequently absent.

Nutrient intake of all respondents was found to be relatively low according to comparison with one-third RDA. It is difficult to determine the significance of this finding, with no information as to the respondent's nutrient intake other than one fast food intake. An obvious recommendation for further study in this area, would be to take 24-hour recalls or more complete dietary records in order to determine the total adequacy of nutrient intake. Another inclusion should be a method to determine the effect of income status on nutrient intake. Use of such a method would indicate if a more affluent population bought more food, and therefore, received greater amounts of nutrients.

It would seem from this investigation that, with the exception of Vitamin A, inadequate nutrient content of fast food restaurant meals results more from the food choices of the individual consumer than from a failure of the menu to provide a variety of nutrient-rich foods. The proposed nutrient labeling legislation for fast food restaurants may help to make consumers more aware of the nutritional value of the fast food menu choices. But knowledge does not always direct action in desired avenues.

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## Appendix A

## The Questionnaire

1. Sex (check one) _____ Male _____ Female

2. Age Group (check one) _____ Below 10 years
_____ 11-14 years
_____ 15-18 years
_____ 19-22 years
_____ 23-50 years
_____ 51 years plus

3. Is cooking equipment available to you in State College?
(check one) _____ Yes _____ No

4. Are you going to use this food as a meal or a snack?
(check one) _____ Meal _____ Snack

5. How often do you eat at this specific fast food restaurant?
(check one) _____ Less than once a week
_____ 1-3 times a week
_____ 3-6 times a week
_____ 6-10 times a week
_____ more than 10 times a week

6. How often do you eat at restaurants like this specific fast food restaurant, which specialize in hamburgers at similar prices?

(check one)

_____ Less than once a week
_____ 1-3 times a week
_____ 4-6 times a week
_____ 7-10 times a week
_____ more than 10 times a week

7. Which of these foods did you order to eat yourself? (check the foods you chose) If you ordered more than one of any food item, put the number in the space before that food.

_____ Large Order Fries
_____ French Fries
_____ Hamburger
_____ Cheeseburger
_____ Filet-O-Fish
_____ Hot Chocolate
_____ Vanilla Shake
_____ Milk
_____ Coffee
_____ Coco Cola, Root Beer, or Orangeade
_____ Chocolate Shake

_____ Big Mac
_____ Quarter Pounder
_____ Quarter Pounder with cheese
_____ Great Fruit Pie
_____ Hot Apple Pie
_____ Cookies
_____ Egg McMuffin
_____ English Muffin with Jelly
_____ Danish Pastry
_____ Juice
_____ Strawberry Shake

## Appendix B

## The Interview Schedule

| Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|
| 7 A.M. | | | 7 A.M. | | 7 A.M. | |
| 10 A.M. | | | 10 A.M. | | 10 A.M. | |
| 1 P.M. | 1 P.M. | | 1 P.M. | | 1 P.M. | 1 P.M. |
| | 4 P.M. | | 4 P.M. | 4 P.M. | | 4 P.M. |
| | 7 P.M. | 7 P.M. | | 7 P.M. | | 7 P.M. |
| | | 10 P.M. | | 10 P.M. | | |

## THE CONTRIBUTORS TO THIS VOLUME

Peter J. Bambic is a Ph.D. candidate in marketing at the Pennsylvania State University. His dual areas of specialization are quantitative methods and consumer behavior.

Stephen Bartlett recently earned a Masters Degree in engineering at the Pennsylvania State University. He was co-author, with Dr. Frank W. Schmidt, of the chapter on food processing equipment in the 1974 "Futures Project" volume, *The Future of Food Service: A Basis for Planning*.

Coleen Patterson Greecher recently received her Masters Degree in nutrition from the Pennsylvania State University. She was co-author, with Dr. Barbara Shannon, of the nutrition chapter in the 1974 "Futures Project" volume, *The Future of Food Service: A Basis for Planning*.

Ruth A. Hartswick is Coordinator of the sensory laboratory for the Pennsylvania State University's Department of Food Science.

Constance E. Kinard, a candidate for an advanced degree in food science at the Pennsylvania State University, is a registered dietitian.

Manfred Kroger, Associate Professor of Food Science at the Pennsylvania State University, is presently engaged in teaching and research in the area of food safety and organoleptic testing.

Charles T. Morrow is Associate Professor of Agricultural Engineering at the Pennsylvania State University.

Arthur H. Patterson holds a doctorate in psychology and is an Assistant Professor in the Man-Environment Relations program of the Pennsylvania State University's College of Human Development.

Thomas F. Powers is Professor in Charge of the Food Service and Housing Administration program at Penn State. He is Director of the FSHA "Futures Project" and the author of several books, courses, and articles in the area of food service.

Leo M. Renaghan is currently pursuing a Ph.D. in marketing at the Pennsylvania State University and concurrently serves as an Instructor in Food Service and Housing Administration.

Mark C. Schechter, a Research Associate in the Pennsylvania State University Economic Department's Center for the Study of Environmental Policy, co-authored the chapter on economics in the 1974 "Futures Project" volume, The Future of Food Service: A Basis for Planning.

Frank W. Schmidt is Professor of Mechanical Engineering at the Pennsylvania State University and is an expert on heat transfer. With Stephen Bartlett, he co-authored the chapter on food processing equipment in the 1974 "Futures Project" volume, The Future of Food Service: A Basis for Planning.

James D. Smith is Professor of Economics at Penn State and Senior Research Fellow with the Urban Institute, Washington, D. C. He co-authored the economics chapter in the 1974 "Futures Project" volume, The Future of Food Service: A Basis for Planning.

John R. Swinton is Editorial Assistant for the Food Service and Housing Administration program at Penn State and for its "Futures Project." He has taught technical writing in the University's English Department.

Ira Wolinsky is an Associate Professor of Nutrition at the Pennsylvania State University. His area of specialization is calcium metabolism.